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The Times They Are A Changin':

Marital Status and Health Differentials From The 1970s To The 2000s

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The Times They Are A Changin':

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Dedication

This dissertation is gratefully dedicated to

my parents, Chunrong Liu and Genqun Li;

my husband, Peng Zhang; and

my son, Alex Tong Zhang.

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Proponents of marriage, both politicians and scholars, emphasize that marriage benefits health and empirical evidence supports the view that the married are healthier than the unmarried. While a significant body of work establishes the link between marital status and health, previous studies do not consider historical trends in this association. The main objective of the present study is to describe whether and how the association between marital status and health has changed over the past three decades in the United States. Given longstanding observations about gender and race differences in family and health processes, the second objective is to consider gender and race variation in marital status/health trends. Third, I consider whether those health trends by marital status can be attributed to change in family income—which is often viewed as an explanatory mechanism between marriage and health.

Results based on three decades' national health survey data show that over the span of the past three decades, the self-rated health of the never-married became more similar to that of the married; in contrast, over this same time span, the self-rated health

of the widowed, divorced, and separated worsened over time, relative to the married. Analyses of two additional health measures (i.e. activity limitation and mortality) show that differences in both activity limitation status and general mortality between the married and each of the unmarried groups—including the widowed, divorced, separated and never married— have widened over recent decades. For each measure of health status, I find important gender and race variation in those health trends by marital status and challenge some long-held assumptions about gender, marital status, and health. Moreover, I find little evidence that family income explains those health trends by marital status. Potential explanations and implications of those trends in health and marital status are discussed.

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Chapter 1. Introduction

Proponents of marriage, both politicians and scholars, emphasize that marriage benefits health and empirical evidence supports the view that the married are healthier than the unmarried and they live longer (Ross, Mirowsky and Goldsteen 1990; Smith and Zick 1994; Waite 1995; Williams and Umberson 2004). While a significant body of work establishes the link between marital status and health, previous studies do not consider historical trends in this association. The main objective of this study is to examine if the differences in health between the married and other marital status groups including the widowed, divorced, separated and never married have increased, decreased or remained stable over the past several decades. I emphasize that documenting historical trends in the overall association is an important first step toward understanding changes in the relationship between marital status and health over time. In this dissertation, I also move one step forward to explore one specific explanatory mechanism (i.e. income change) as well as gender and race variation in those trends.

Several factors may contribute to changing patterns in the link between marital status and health. The sociodemographic composition of marital status groups (e.g., SES, race) has changed over time and these variables are also associated with health. Moreover, the past several decades have witnessed rapid change in predominant family structures and norms in the United States—and these changes may alter the link between marital status and health. For example, divorce is more common and normative now than in the past. As a result, divorce may carry less stigma and produce less stress, thus alleviating some of the adverse effects of divorce on health. Even though there are reasonable theoretical, albeit slimmer empirical, grounds for expecting the association

between marital status and health to vary across time, little research has attempted to ascertain whether this association is invariant across historical time. This dissertation is designed to address these significant gaps in knowledge with the following primary aims:

1. to determine whether and how the relationship between marital status and health changed across historical time during recent decades, from the1970s to the 2000s;
2. to explore whether those health trends by marital status can be attributed to change in family income—which is often viewed as an explanatory mechanism between marriage and health; and
3. to consider if and how this dynamic process differs among different socio-demographic groups, including race and gender groups.

Self-rated health, activity limitation status and mortality are the three primary dimensions of health examined in this study. Two datasets are used to address these specific aims of the present study. The first dataset is the repeated cross-sectional data from the National Health Interview Survey (NHIS), 1972-2003, which is used to examine trends in marital differences in self-rated health and activity limitation status. Ordered logistic and binomial logistic regressions are used to analyze changes in these two health outcomes by marital status respectively. The second dataset is specifically for the analyses of mortality trends, which is from the National Health Interview Survey-Multiple Cause of Death (NHIS-MCD), 1986-2000. Those mortality data are the linked files of the National Health Interview Survey to the National Death Index, 1986-2000 with follow-up through the end of 2002 (www.cdc.gov/nchs/r&d/nchs_datalinkage/nhis_data_linkage_mortality_activities.htm).

Cox proportional hazards models are used to estimate general mortality trends by marital status.

This dissertation is composed of six chapters including this introduction (Chapter 1). In Chapter 2, I develop five specific research hypotheses about health trends by marital status from the 1970s to the 2000s in the United States derived from past theoretical and empirical work. Chapters 3-5 empirically test those hypotheses using the three health measurements respectively: self-rated health, activity limitation status and mortality. In chapter 6, I discuss the possible explanations and implications of those identified trends in health and marital status and close this dissertation with some general conclusions.

Chapter 2. Background and Research Hypotheses

Marriage has received substantial theoretical and empirical attention not only because it is a fundamental institutional unit in society, but also because substantial research evidence shows that involvement in marriage is associated with improved health and reduced mortality risk (Umberson 1987; Waite 1995; Rogers, Hummer, and Nam 2000). This has been the case since the earliest sociological studies and continues today with studies of marriage that rely on up-to-date, sophisticated statistical techniques and longitudinal data (House, Landis and Umberson 1988).

During recent decades, the United States has witnessed tremendous changes in all social institutions, of which marriage is one of the most often documented. Average age at first marriage increased; cohabitation and marital dissolution rose dramatically; and the proportion of never married (especially for African Americans) increased (Teachman, Tedrow and Crowder 2000; Casper and Bianchi 2001). Figure 2.1 shows the median age at first marriage of Americans during the last century. For both men and women, the median age at first marriage increased steadily since the 1950s in the United States. Figure 2.2 shows that the U.S. divorce rate increased remarkably over the last century. This increase did not stop until the 1980s. All of those changes suggest trends toward a retreat from formal marriage in the United States.

Some family scholars argue that such changes provide evidence that marriage has become less popular and valued among Americans (Bumpass 1990). Happiness associated with marriage seems to have waned from 1972 to 1986 (Glenn and Weaver 1988) suggesting that the benefits of marriage may have lessened over time. As the proportion of individuals who divorce and never marry increases, these statuses also

become more normative and less stigmatized (Thornton 1985, 1989). Corresponding to changes in meanings and beliefs about marriage, the impacts of marital gain and loss on health may also change over time (Simon and Marcussen 1999; Simon 2002; Williams 2003).

While researchers continue to emphasize the value of marriage for health, we know surprisingly little about how the association between marital status and health has changed over historical time. Although previous studies provide little empirical evidence regarding historical change in the link between marital status and health, historical change in family formation and dissolution suggests potential change in the association between marital status and health over time. I expect the association between marital status and health to vary from the 1970s to the 2000s, a period characterized by rapid family change. Certainly, the meaning and structures of marriage and the family have changed substantially over the past three decades, and one would expect change in the relative costs and benefits of these statuses for health.

Knowledge gained from this study is particularly important for family and public health researchers and policy makers in the context of current debates about marriage benefits for health. While some scholars argue that marriage should be encouraged because it is beneficial to health and well-being (Waite and Gallagher 2000), other scholars argue that marriage is not as strongly linked to individual well-being as it was in the past as alternatives to marriage (e.g. cohabitation, same-sex units) become more common and socially acceptable (Musick and Bumpass 2006; Hull 2006). The importance of this issue is highlighted by the strong emphasis currently placed on public policies designed to encourage marriage. These policies are based, in part, on the assumption that marriage provides a "haven in a heartless world,"—a haven that protects

health in our mobile society perhaps more so now than ever before (Lasch 1977; Waite and Gallagher 2000). An analysis of trends in marital status and health over time should shed light on the nature of these linkages as well as implications for population health presently and in the future.

WHY THE MARRIED ARE HEALTHIER—PREDICTING THE DIRECTION OF CHANGE

A substantial literature has established the existence of the relationship between marital status and health with better health among the married (Umberson 1987; Ross, Mirowsky and Goldsteen 1990; Waite 1995), and recent research has focused on identifying and understanding the key reasons for the association between marital status and health. The primary explanations for this association are "resources" offered by marriage (Umberson 1987; Ross, Mirowsky and Goldsteen 1990), "stress" imposed by transitions out of marriage (Booth and Amato 1991; Williams and Umberson 2004), and "selection" of healthier people into marriage (Fu and Goldman 1996; Joung et al. 1998). Both the protection and stress arguments suggest that the association between marital status and health is a causal relationship while the selection argument suggests that it is a spurious association.

The Marital Resource Model

The marital resource model suggests that health differences by marital status can be explained by social integration, regulation of health behavior and the greater economic resources which the married enjoy relative to the unmarried (Ross, Mirowsky and Goldsteen 1990; Waite and Lehrer 2003).

Social Integration, Social Support and Psychological Well-being. Marriage may promote physical health by providing network connections and social support as well as

improving psychological well-being (Pearline and Johnson 1977; Horwitz, White and Howell-White 1996b; Lamb, Lee and DeMaris 2003). Marriage reinforces social integration by extending involvement in social relationships which are themselves a source of benefits (House, Landis and Umberson 1988). Involvement in social relationships provides individuals with a sense of obligation to others, which reinforces social integration (House, Landis and Umberson 1988). In addition, marriage may protect health through increasing social support and perceived security (Ross, Mirowsky and Goldsteen 1990; Ross and Mirowsky 2002). Social integration and social support are positively associated with psychological well-being which, in turn, is positively associated with physical health and mortality risk (Bloom 1990).

Social Control and Health Behavior. Marriage provides external regulation and facilitates self-regulation of health behaviors both of which can affect physical health and mortality (Umberson 1987). Numerous studies demonstrate an association between marriage and health behavior but not always in the expected direction (Grzywacz and Marks 1999). The married are more likely to weigh more and get less physical exercise than the unmarried (Ross, Mirowsky and Goldsteen 1990). The marital benefit for health behavior is more apparent for smoking and drinking behaviors. The married, especially men, show dramatically lower levels of alcohol and cigarette consumption than their unmarried counterparts (Umberson 1992; Chilcoat and Breslau 1996).

Economic Resources. Marriage leads to an increase in economic resources through several mechanisms. First, married couples are more likely to pool their wealth and income together than others, including cohabitors (Waite 1995; Brines and Joyner 1999), which increases available economic resources for spouses. Second, division of labor and specialization permit spouses to produce and consume more efficiently (Becker

1981). This specialization is unattractive to cohabitors who are more likely to remain together under conditions of equality (Brines and Joyner 1999). Third, married couples can benefit from economies of scale. Moreover, a great number of studies show that marital dissolution through either divorce or widowhood may lead to economic hardship (Smith and Zick 1986; Smock, Manning and Gupta 1999). Economic resources enhance health by improving nutrition, providing care in case of illness, and allowing purchase of medical care or other health enhancing resources (Lillard and Panis 1996), whereas economic hardship is detrimental to health by increasing stress (Mirowsky and Ross 2003).

Even though marriage may provide substantial resources for health, we see an increasing proportion of the U.S. population choosing to stay outside of marriage (Casper and Bianchi 2001). One of the most influential theories explaining marriage changes is from the economist Gary Becker (1981), who attributes recent trends toward a retreat from formal marriage to a decline in gains from marriage. According to Becker, people get married in order to maximize their utility. Marriage makes individuals better off partly by allowing for specialization between the husband and wife, which yields greater productivity (Becker 1981). As the division of household labor decreases with increases in women's education and employment, specialization between spouses declines and the economic gain from marriage diminishes. Marriage becomes less valued as a source of economic stability (Teachman, Tedrow and Crowder 2000). Thus, individuals have become less inclined to stay married. As aforementioned, one of the mechanisms through which marriage benefits health is increased economic resources. If women's employment and independence diminish the benefit of specialization between spouses and thus reduce

the economic gains of marriage, then the marriage benefits for health may have waned over time.

While Becker's arguments are widely cited and supported from cross-sectional aggregate-level evidence, longitudinal analyses of individual-level data fail to support this hypothesis (see a review in Oppenheimer 1997). Moreover, not all protective resources associated with marriage have diminished over time. Empirical evidence on change in social and psychological resources (e.g., social support, regulation of health behavior) are not as well documented as change in economic gains from marriage, but some indirect evidence is suggestive. For example, in the context of increasing geographic mobility, marriage becomes more important in providing network connections and social support because of greater decreases in non-kin networks (McPherson, Smith-Lovin and Brashears 2006). In this sense, marriage may become more important for health and health differences by marital status may have increased over time.

Stress "Crisis" Model

In contrast to the marital resource model which attributes marital benefits to the positive effects experienced by the married, the stress model attributes health differences by marital status to the negative effects associated with transitions out of marriage. The stress model suggests that the strains of marital dissolution, instead of marriage itself, are the primary factor responsible for undermining the health of the divorced, separated and widowed which, in turn, leads to marital status differences in health (Booth and Amato 1991; Williams and Umberson 2004).

Recent research adds to growing empirical support for the stress model. Marital disruption appears to substantially increase psychological stress and decrease subjective

well-being, which could result in unhealthy outcomes (Booth and Amato 1991). Booth and Amato (1991) find that divorce increases depression for about two years following divorce and depression levels decrease to the baseline level by about two years after divorce whether the individual remarries or not. Williams and Umberson (2004) find that the continually divorced and never married do not differ in self-rated health compared to the continually married in a national survey. However, they find that the transition to divorce does affect health, especially for men; recently widowed men also exhibit a significant decline in health while long-term widowhood is not associated with poorer health. A more recent study by Strohschein et al. (2005) suggests that losing a spouse brings more distress than gaining one brings well-being. These studies are more consistent with a stress model than a protection model in explaining health differences by marital status.

Presumably, marriage benefits individuals, in part because the married are protected from the adverse effects of being in other family structures, such as divorced, separated, never married, widowed, and cohabiting families. However, those non-married family structures have become much more prevalent in the United States and the stigma associated with those statuses has declined over time (Thornton 1985, 1989). Normative and attitudinal changes could lead to dampened negative effects from marital dissolution and other non-married family structures. In this sense, marital differences in health should have decreased over time.

Selection Model

The selection model suggests that individuals in better health or with more favorable health characteristics are more likely to be selected into marriage while those in worse health or with fewer favorable health characteristics are more likely to be selected

out of marriage. Spouses may be selected for better health not only *directly* through the exclusion of mentally and physically ill persons from marriage but also *indirectly* through a wide range of selection criteria including socioeconomic status (Oppenheimer, Kalmijn and Lim 1997), health behaviors (Fu and Goldman 1996), and psychological characteristics (Mastekaasa 1992).

Marriage selection works through two stages. The first stage occurs because individuals in better health or with more favorable health characteristics are more likely to experience transitions into marriage. Research about marriage formation suggests that low socioeconomic status (especially for men) and being African American are both negatively associated with the likelihood and timing of marriage (Oppenheimer, Kalmijn and Lim 1997). Although not as well documented as income, education, and race, other selection criteria such as psychological well-being (Masterkassa1992; Forthofer et al. 1996) and health behavior (Fu and Goldman 1996) may also be operative.

The second stage of marriage selection on health occurs because those in poorer health or with fewer favorable health characteristics are more likely to experience transitions out of marriage. Joung et al. (1998) find that individuals in poorer health are more likely to get divorced and selected out of marriage. Raley and Bumpass (2003) suggest that lower socioeconomic status, African American identity and fewer socioeconomic resources are all associated with higher risk of union dissolution and that the differentials in marital dissolution between those social groups have increased since the 1980s.

Change in the relative number of individuals selected into or out of marriage suggests that selection criteria may have changed in the context of rapid family change. Changes in marriage selection suggest that the association between marital status and

health would change over time, although predictions about the direction of change are unclear. On the one hand, more people divorce, separate, never marry, and cohabit, suggesting that the negative criteria associated with selection out of marriage may have diminished so that disadvantages associated with those non-married statuses may have diminished over historical time. On the other hand, fewer people get married suggesting that selection into marriage may have become more relevant over time and the advantage of the married over the non-married may have increased.

Taken together, changes in the marriage protection, stress and selection processes suggest that the association between marital status and health has changed over time, although predictions about the direction of change are unclear. Two competing hypotheses emerge from these literatures:

Competing Hypothesis 1: Health differentials between the married and other marital status groups decreased over the past three decades.

Competing Hypothesis 2: Health differentials between the married and other marital status groups increased over the past three decades.

The argument about a decline in economic benefits from marriage suggests a hypothesis about one potential explanation for marital status-health trends:

Hypothesis 3: Trends in health differentials by marital status can be attributed to changes in family income inequality.

GENDER AND RACE VARIATION

Since the early 1970s, sociologists have emphasized that marriage benefits the health of men more than women (Bernard 1972; Gove 1972, 1973). The adverse effects of marital dissolution also seem to be greater for men than for women (Williams and Umberson 2004). Marriage benefits health in different ways depending on gender in that women benefit more from the economic benefits of marriage whereas men benefit more from the social/emotional support and health regulation offered by marriage (Waite 1995). Because greater economic resources through marriage play a more important role in accounting for the marital advantage in health and mortality for women than for men (Lillard and Waite 1995; Zick and Smith 1991), the decline in economic gains from marriage may reduce the marital advantage in health for women more than for men. Moreover, norms and attitudes about non-married statuses have changed more for women as a result of women's greater improvement in social and financial status over time (Thornton 1989). This may lead to a more modest negative effect of the non-married statuses for women's health than for men's over historical time. These literatures lead to the following hypothesis regarding gender differences in marital status-health trends:

Hypothesis 4: Health differentials by marital status are more likely to decrease and/or are less likely to increase for women than for men.

Marriage trends also vary quite a bit across racial groups within the United States. Among Whites, declines in marriage largely represent delays in marriage, whereas, among African Americans, declines reflect both delays and decreases in the probability of ever marrying (Bennette, Bloom, and Craig 1989). Being African American is

associated with a higher risk of union dissolution (Raley and Bumpass 2003) as well as a lower likelihood of transition into marriage (Oppenheimer, Kalmijn and Lim 1997). Although the probability of divorce has remained constant since the 1980s in the United States (Goldstein 1999), the plateau in divorce exists only among Whites and not among African Americans (Raley and Bumpass 2003). According to Raley and Bumpass (2003), race differences in the risk of union dissolution have increased over recent decades. The more rapid increase in marital dissolution among African Americans indicates that the marriage benefits may be declining more rapidly for African Americans than for Whites. Indeed, African American women gain less from marriage than do White women (Farley 1988). Moreover, the more common occurrence of divorce, separation, cohabitation and never-married statuses among African Americans compared to Whites suggests that being unmarried might be more normative for African Americans than for their White counterparts. This may result in more dampened negative effects from those non-married statuses for African Americans than for Whites. This leads to the following hypothesis regarding race differences in these trends:

Hypothesis 5: Health differentials by marital status are more likely to decrease and/or are less likely to increase for African Americans than for Whites.

PREVIOUS EMPIRICAL EVIDENCE

Recent changes in marriage and the family suggest some reasons to expect the married and unmarried groups to experience convergent trends in health. However, previous empirical evidence, mostly based on European mortality data, does not support this view (see Van Poppel and Joung 2001; Martikainen 2005; Valkonen, Martikainen

and Blomgren 2004). Most of those European studies argue that the excess mortality of the unmarried—including the never-married, widowed, and divorced—relative to the married has increased over time and they conclude that this occurs primarily because of more pronounced improvements among the married, rather than a worsening situation for the unmarried (Van Poppel and Joung 2001). The European mortality data suggest that health status of the married relative to the unmarried has actually improved over time.

An earlier study conducted by Hu and Goldman (1990) also includes U.S. mortality data along with data from several other developed countries, mostly European. This study also revealed a widening mortality gap between the married and each of the unmarried groups including the never-married, widowed, and divorced in the United States between the 1950s and the 1980s. Another study examined mortality trends by marital status in the United States (Mergenhagen, Lee and Gove 1985) using two datasets to compare marital status differences in mortality among Whites between 1959-1961 and 1979. Different from the findings of Hu and Goldman (1990), Mergenhagen, Lee and Gove (1985) found that the relative mortality difference between the divorced compared with the married declined between 1959-1979 while the opposite was true when comparing the widowed and never married. The authors speculate that the reason for the decreased disadvantage of the divorced relative to the married is greater social acceptability of divorce in more recent years.

Hu and Goldman (1990) and Mergenhagen, Lee and Gove (1985) are the only two studies that consider marital status trends in mortality over historical time in the United States. As useful as they are, both studies are quite dated. Moreover, neither considers potential social group differences, yet the research literature suggests reasons to expect

potential differences in the martial status and mortality trends by race and gender—as discussed earlier.

A recent study using data from the U.S. General Social Survey by Linda Waite (2000) reports a stable rather than changing marital benefit for several dimensions of well-being, including self-rated health status, over the 1972 to 1996 period. Waite (2000) finds marginally significant (p=.076) evidence for a shrinking difference in self-rated health between married and never married men, but not women, over time. Waite (2000) classifies all of the previously married groups into one group without distinguishing among the divorced, separated and widowed. Yet one would expect health differences across these marital status groups as well as potentially different patterns of change in those differences over time. Mortality certainly varies across marital status groups and the transition into divorce and widowhood may precipitate, at least temporarily, health decline (Williams and Umberson 2004). Self-rated health is the only physical health measure in the study of Waite (2000), and I argue that multiple dimensions of health measurement contribute to our understanding of social inequality in population health. Moreover, none of the previous studies consider potential social group differences, while the research literature provides reasons to expect potential differences in those martial status and mortality trends by race and gender—as discussed earlier.

This present study addresses most of the limitations of the previous studies. In this study, I use the latest national data in the United States as well as multiple dimensions of health measurement. I adopt more detailed classifications of marital status. Potential social group variation is also considered in this study. In the next three chapters, I empirically investigate trends in the relationships between marital status and three

dimensions of health status in the United States from the 1970s to the 2000s: self-rated health, activity limitation status and mortality.

Chapter 3. Marital Status and Self-Rated Health 1972-2003

Self-rated health is one of the most often used health measures in social science and its reliability and validity is well-established by previous studies (Idler and Benyamini 1997, DeSalvo et al. 2006). In this chapter, I use self-rated health as a measure for health status and investigate marital status differences in self-rated health trends from 1972 to 2003 in the United States.

DATA AND SAMPLE

I use repeated cross-sectional data from the National Health Interview Survey (NHIS) from 1972 to 2003 to analyze historical trends in marital status differentials in self-rated health. The NHIS is a multistage probability survey conducted annually by United States Department of Health and Human Services and the National Center for Health Statistics and is representative of the civilian noninstitutionalized population of the United States (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2000a). All analyses presented here are weighted to adjust for this sampling design and robust standard errors are used for tests of significance. This sampling survey weight takes account of the selection probability, nonresponse, and post-stratification adjustment. I do not adjust the strata and cluster for calculating the standard errors because NHIS did not provide a constant method for these adjustments (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2005; Goesling 2007).

In this study, I include only those persons who are non-Hispanic White or African American and between the ages of 25 and 80 when the surveys were conducted. Individuals from other racial and ethnic groups are dropped from the analysis because of their tremendous heterogeneity and because of lack of full identification information

across all survey years in the NHIS data. NHIS collects health information for all family members but information on each family member is reported by one primary respondent at home (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2000b). Due to concerns about validity and reliability of proxy reports on family members' health, my analyses are limited to the primary respondents' reports on his/her own health status. I exclude cohabiting respondents from the analysis which account for 0.7 percent of the sample because the NHIS did not collect information on cohabitation prior to 1997. Results (not shown in this dissertation) including the cohabitation cases as either married or a separate group reveal results that are similar to my final reported results, suggesting that exclusion of cohabitation cases does not bias my estimations. Missing cases on health status or marital status were dropped from the analysis and account for about 1% of the total sample. In total, 1,119,266 observations are included in the analysis.

Table 3.1 presents descriptive information on the pooled NHIS sample composition from 1972 to 2003 and shows that about 67 percent of the total sample is currently married. The widowed account for about eleven percent of the sample. The divorced and never married each account for about ten percent of the sample. About three percent of the sample is separated. The mean age of the sample is around 48 and more than half are women. This sample is more female-oriented than what might be expected because women were more likely than men to be the main household respondents in this survey. About eleven percent of the sample is African American. In the total sample, about 29 percent have no high school diploma and about 37 percent are high school graduates. Those with some college but less than four years of college account for almost 17 percent of the sample. College graduates account for about 17

percent. The median family income of the pooled sample is about $40,422 based on 2003 dollars.

MEASURES

Self-rated health is the primary outcome variable in the analyses. Between 1972 and 1981, response options for self-rated health included four categories: 1) excellent, 2) good, 3) fair, and 4) poor. Between 1982 and 2003, response options included five categories: 1) excellent, 2) very good, 3) good, 4) fair, and 5) poor. I combine "very good" and "excellent" into one category for those interviewed between 1982 and 2003 so that response categories are comparable to those used between 1972 and 1981 (see Lynch 2006). Final statistical models include a dummy variable to indicate whether self-rated health was recoded from the five to the four category response format (1=recoded/survey since 1982; 0=not recoded/survey before 1982). Self-rated health is recoded so that higher values represent better health. For ease of interpretation, I refer to the highest two health categories (i.e., excellent and good health) as "good health" in the remainder of the dissertation. The reliability and validity of the self-rated health measure is well-established (Idler and Benyamini 1997; DeSalvo et al. 2006).

Marital status is based on the survey question, "Are you now married, widowed, divorced, separated or never married?" Five categories of marital status are considered: married, widowed, divorced, separated, and never married, with the married as the reference group.

Period time is indicated by a variable identifying the survey year from 1972 (coded as 0) to 2003 (coded as 31).

Other socio-demographic covariates in the analysis include gender (female=1, male=0), race (non-Hispanic African American=1, non-Hispanic White=0), age (in one

year units and centered at mean age of 48), and education (no high school diploma, high school graduate, some college, and college graduate with the last category as the reference group). All of these variables are potential confounders for the relationship between marital status and health. About one percent of the observations have missing information on education and they are recoded at the mean value for the survey year. In the remainder of the dissertation I refer to non-Hispanic Whites as "Whites" and to non-Hispanic African Americans as "African Americans". Because the marital association with health depends on age (Umberson et al. 2006), the estimated period trends will be biased if the age interaction is ignored (see Lynch 2003). In order to control for the age pattern of the marital status differences in health, I include interaction terms between age and marital status in my final models.

Family income is also considered in the analysis. Because of the endogenous relationship between income and marital status (Becker 1981), family income serves a different purpose than the other socio-demographic covariates in the analysis. Family income is added into the analysis in order to examine if and how changes in economic resources mediate the pattern of changes in health differences by marital status across historical time. The NHIS measure of family income is not consistent across survey year in that both the cut points and total number of categories are changed. I use the midpoint of each income category and then adjust them into 2003 U.S. dollars according to the consumer price index. I then use the logarithmic transformation of family income to address the skewed income distribution (see Lynch 2006).

ANALYTIC DESIGN

Two strategies are typically used to analyze historical trends: analysis of cohort effects and analysis of period effects. Period trend studies, compared to cohort trend

studies, are more likely to reflect historical events (e.g. family change) (Yang 2006). In the present study, I focus primarily on period trends of marital status differences in health. I use ordered logistic regression estimation for the conventional age-period-cohort model (with cohort effect omitted). Ordered logistic models are appropriate for ordinal categorical outcome variables such as self-rated health in this study (Powers and Xie 2000). The model can be expressed in the following way:

$$\log \frac{p(y \geq k \mid X_i, M_j, T)}{p(y < k \mid X_i, M_j, T)} = \tau_k + \alpha T + \sum \beta_j M_j + \sum \gamma_j M_j T + \sum \pi_i X_i$$

Where y represents the outcome variable indicating health status; k represents the category of health status; τ_k represents the intercept corresponding to the kth health category; T is the period time variable and α is the coefficient; M_j represents the set of marital status dummy variables and β_j represents the corresponding coefficients ("married" is the reference group); γ_j represents the corresponding coefficients for the set of interaction terms between marital status and time; X_i stands for the other covariates included in the model and π_i for the corresponding coefficients. γ_j is of the most interest for this study as it reflects trends in health differences by marital status.

I include two models in the analysis. In the first model, I examine health trends by marital status controlling only the basic socio-demographic covariates (i.e. age, gender, race, education and ageXmarital status). Results from Model 1 reflect the overall trends in the association between marital status and health. I add family income in the second model to see how income may modify health trends by marital status. In both models, I include a dummy variable indicating the 1982 NHIS survey change. I run parallel regressions for women, men, African Americans and Whites to determine if historical trends differ on the basis of gender and race. Two-tailed t-tests are conducted

to determine whether the differences in trends between subgroups are statistically significant.

DESCRIPTIVE RESULTS

Table 3.2 provides descriptive statistics for three selected survey years: 1972, 1987 and 2003. This table indicates that, over time, the proportion of married or widowed in the sample declined while the proportion of divorced or never married increased. The proportion of the separated showed a modest decline over time. For each marital status group, the proportion reporting good health generally increased over time, and the proportion of college graduates increased as well. Consistent with the argument about a decline in economic benefits from marriage, in this sample the median family income decreased for the married group from 1972 to 2003, while it generally increased nonlinearly for the unmarried groups. Nevertheless, the married have the highest family income at all of the three time points.

The married and never married generally include a higher proportion reporting good health than do the divorced, separated or widowed, with the widowed, on average, having the lowest proportion reporting good health. For each selected year, the never married include the highest proportion of college graduates followed by the currently married. The widowed, divorced and separated have relatively smaller proportions of college graduates. As expected, the widowed are the oldest group while the never married are, on average, the youngest. The married include a smaller proportion of African Americans than do other marital status groups. The widowed include the largest proportion of women among all marital status groups. These descriptive results are consistent with well-documented associations of, as well as historical trends in, marital

status, health, education, gender and race in the United States (U.S. Census Bureau 2006; Mirowsky and Ross 2003; Umberson and Williams 1999).

ESTIMATED TRENDS FROM ORDERED LOGISTIC REGRESSION MODELS: TOTAL SAMPLE

Tables 3.3-3.5 show the estimated trends in self-rated health by marital status from the weighted ordered logistic regression models. Table 3.3 shows health trends by marital status for the total sample over the 1972 to 2003 period. Tables 3.4 and 3.5 indicate that there is significant gender and race variation in those trends and will be discussed in a later section. The first set of covariates in Tables 3.3-3.5 (i.e., Year*Marital Status) are of the greatest interest for this study because they reflect trends in self-rated health by marital status. The main effect of "Year" indicates the trend for the married. For example, the coefficient of 0.003 for "year" in Model 1 of Table 3.3 can be interpreted as follows: The odds of reporting good (i.e. excellent/good health) health increased 0.30% (i.e., [exp(0.003)-1]*100%) each year for the married. The interaction terms of "Year" with other marital statuses represent the differences in self-rated health trends between each specific marital group and the married. For example, the coefficient of -0.023 for "year*widowed" in Model 1 of Table 3.3 can be interpreted as: The odds of reporting good health decreases 2.27% (i.e., [1-exp(-0.023)]*100%) *more* for the widowed than for the married each year. The main effects of the marital status variables in Tables 3.3-3.5 reflect the baseline level (i.e. at the beginning of the study period, 1972) of health difference between the specific marital groups and the married. For example, the coefficient of -0.202 for "separated" in Model 1 of Table 3.3 can be interpreted as: In 1972, the odds of reporting good health is 18.29% lower (e.g., [1-exp(-0.202)]*100%) for the separated than the married. Other covariates can be interpreted in the same way that

coefficients in conventional ordered logistic regression models are interpreted. Exponentiation of the values for cut 1-3 represent odds of reporting different levels of health status for the reference group (e.g. married White men who are college graduates and 48 years old) (see Powers and Xie 2000).

Estimated effects of all of the covariates are in the expected directions. Specifically, the odds of reporting good health decline with age and they are smaller for African Americans compared to non-Hispanic Whites. Women are less likely to report good health than men. In comparison to college graduates, each of the lower education groups exhibits lower odds of reporting good health.

Model 1 of Table 3.3 shows the estimated trends in health differences by marital status for the total sample over the 1972 to 2003 period, net of the effects of age, ageXmarital status, gender, race, and education. I calculate the probability of reporting good health (i.e. excellent/good health) based on the results in Model 1 of Table 3.3. I illustrate the overall pattern of these results in Figure 3.1. These results indicate that, over the 1972 to 2003 period, the probability of reporting good health increased moderately among the married while it increased at a more rapid rate among the never married, leading to a narrowing health gap between the never married and married over time.

In contrast, over the past three decades, the probability of reporting good health declined among the divorced, separated, and, especially, the widowed. Therefore, the health difference between the married and the widowed/divorced/separated widened over the 1972 to 2003 period. The health gap between the married and formerly married increased most for the widowed. Net of sociodemographic characteristics, the widowed and the married reported similar levels of health in the early 1970s but as the years

passed, the health of the widowed decreased at the most rapid rate compared to all other marital status groups.

I add family income as an additional covariate in Model 2 of Table 3.3 to see if and how family income contributes to health trends between marital status groups. Controlling family income results in little change in the health trends by marital status from Model 1 to Model 2 (shown in Table 3.3). These results suggest that marital status differences in family income do not explain either the convergent trend between the married and never married or the divergent trend between the married and each of the formerly married groups—the divorced, separated, or widowed.

GENDER AND RACE VARIATION IN ESTIMATED TRENDS FROM 1972 TO 2003

Tables 3.4 and 3.5 present the estimated trends in health differences by marital status from the weighted ordered logistic regression models for separate social groups. Both model estimation and two-tailed t-tests for group differences are presented in each table.

Gender

Table 3.4 shows the estimated trends in self-rated health from 1972 to 2003 by marital status separately for women and men. Results from Model 1 of Table 3.4 are illustrated in Figure 3.2 and show that the probability of reporting good health increases over historical time for married women while the probability remains stable for married men. Notably, the married remain more likely than any other marital status group to report good health for both men and women over the entire study period.

The never-married became increasingly more likely to report good health over time. This is true for both men and women. Furthermore, because the probability of

reporting good health remains stable for married men, there is a trend toward health convergence for married and never-married men over time. In contrast, the gap between married and never-married women remained stable from 1972 to 2003—suggesting that, contrary to my predictions, any association of marriage with good health has decreased for men, but not for women, over the past three decades. In fact, although we see a much wider gap in the probability of reporting excellent/good health between the married and never married for men than for women at the beginning of the study period (i.e. 1972), the gap between the married and never married looks very similar for men and women at the end of the study period (i.e. 2003).

The formerly married—the separated, divorced, and widowed—all exhibit a decline in health over time relative to the married for both women and men. In fact, in 1972, widowed and divorced women have the same probability of reporting excellent or good health as married women. In contrast, previously married men are less likely to report excellent/good health than married men in 1972. As time goes on, for both men and women, the previously married groups become worse off, relative to the married. Two-tailed t-tests show that divergence between the married and widowed/divorced is more pronounced for women than for men. The gender difference in the self-rated health gap between the married and previously married diminishes over time. Moreover, over the thirty year period, the gap between the separated and divorced is always larger for women than for men with separated women less likely than divorced women to report good health at any time point. This finding supports a stress model interpretation in that the process and dynamics of separation may be more stressful and detrimental to health than divorce for women whereas, among men, it appears that separation and divorce are more similar in their association with health.

In Model 2 of Table 3.4, I add family income as an additional covariate; this results in little change in the estimated trends of health differences by marital status for either women or men. This suggests that family income inequality does not explain the trends in health differences by marital status for either women or men.

Race

Table 3.5 compares the estimated trends in self-rated health by marital status for Whites and African Americans. I illustrate the results from Model 1 of Table 3.5 in Figure 3.3. Overall, African Americans are less likely than Whites to report being in good health. However, over time, the probability of reporting good health was more likely to increase for the average African American relative to Whites.

Marital status and health trends follow very different patterns for African Americans compared to Whites. The general pattern of racial differences can be seen in Figure 3.3 which shows the probability of reporting good health by race and marital status over time. Married African Americans exhibit a dramatic increase in the probability of reporting good health over the thirty year period while the improvement in health over time occurs at a much slower rate for married Whites. The health gap between married Whites and married African Americans narrowed significantly over the thirty year period. This narrowing race gap in health is also seen for the never-married and the divorced/separated, but not for the widowed.

Consistent with my predictions, Figure 3.3 also illustrates a strong convergence between the never married and married among African Americans but a much less pronounced convergence among Whites from 1972 to 2003. The two-tailed t-test (shown in Model 1 of Table 3.5) shows that this race difference between the never married and married is statistically significant. This is consistent with my hypothesis that married and

never-married African Americans are more likely than Whites to experience health convergence over time.

While the probability of reporting good health increased for divorced/separated African Americans over the thirty year period, it decreased for divorced/separated Whites. For both racial groups, the widowed became less likely to report good health over time. Furthermore, for both Whites and African Americans, there are widening health gaps between the married and widowed/divorced from 1972 to 2003. Two-tailed t-tests show that there are no significant racial differences in *changes* in the health *gap* between the married and each of the formerly married groups.

Results from Model 2 of Table 3.5 show that the modest convergence trend between the never married and married among Whites is explained by change in family income. As shown in Model 2 of Table 3.5, if never married Whites had the same family income as married Whites, they would have a stable health gap over time. This is consistent with the hypothesis that a decline in economic gains from marriage over time leads to a convergent trend in health between the married and unmarried. However, this explanation holds only for Whites, not for African Americans.

SUMMARY

In this chapter, I investigated trends in self-rated health by marital status using the pooled data from the National Health Interview Survey from 1972 to 2003. The results from ordered logistic regression models show that:

1) The self-reported health status of the never-married became more similar to that of the married over the past three decades;

2) In contrast, the self-reported health of the widowed, divorced, and separated worsened over time, relative to the married;

3) The trend toward health convergence between the married and never married exists for men but not for women. The trend toward health divergence between the married and formerly married is more pronounced for women than for men;

4) The convergence trend between the married and never married is more pronounced for African Americans than Whites; and

5) Among Whites, the trend toward health convergence between the married and never married is explained by the relative decline of family income among the married in comparison to the never married. However, this explanation holds for Whites but not for African Americans.

Although self-rated health status is one of the most often used health measures in social science, the self-rated health measure may pose unique problems for an analysis of historical trends. Historical improvements in medical technology, public health campaigns, and personal knowledge about health may have led individuals to be better informed about their health status and, thus, provide more accurate reports of health over time. The standards for classifying oneself as in good or bad health may also have changed over time. Despite these limitations, self-rated health is a reliable and valid measure for health status for both women and men (Idler and Benyamini 1997). In the next two chapters, I examine trends in activity limitation status and mortality by marital status in an effort to broaden the assessment of historical change in marital status and a range of health outcomes.

Chapter 4. Marital Status and Activity Limitation Status 1983-2003

In comparison to self-rated health, activity limitation status is less subjective and vulnerable to historical changes in expectations. In this chapter, I use activity limitation status as a measure for health status and investigate marital status differences in trends in activity limitation status from 1983 to 2003 in the United States.

DATA AND SAMPLE

Data are from the National Health Interview Survey (NHIS). Due to the lack of comparability in the NHIS for activity limitation status before and since 1983 (U.S. Department of Health and Human Services and NCHS 1985), I analyze historical trends in marital status differentials in activity limitation status using repeated cross-sectional data from the National Health Interview Survey (NHIS) from 1983 to 2003. All analyses presented here are weighted to adjust for the sampling design and robust standard errors are used for tests of significance. This sampling survey weight takes account of selection probability, nonresponse, and post-stratification adjustment. I do not adjust the strata and cluster for calculating the standard errors because NHIS did not provide a constant method for these adjustments (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2005; Goesling 2007)

Similar to the analysis for self-rated health in Chapter 3, I include only those who are non-Hispanic White or African American and between the ages of 25 and 80 when the surveys were conducted. The analyses are limited to the primary respondents' reports on his/her own activity limitation status. I exclude cohabiting respondents from the analysis because of the lack of information on cohabiting status prior to 1997. Missing cases on activity limitation status or marital status were dropped from the analysis and

account for about 1% of the total sample. In total, 689,922 observations are included in the analysis.

Table 4.1 presents descriptive information on the pooled sample composition and shows that about 63 percent of the total sample is currently married. The widowed account for about ten percent of the sample. The divorced and never married each account for about twelve percent of the sample. About three percent of the sample is separated. The mean age of the sample is around 48 and more than half are women. About twelve percent of the sample is African American. In the total sample, about 18 percent have no high school diploma and about 36 percent are high school graduates. Those with some college but less than four years of college account for almost 23 percent of the sample. College graduates account for about 23 percent. The median family income of the pooled sample is about $39,344 based on 2003 dollars.

MEASURES

Activity limitation status is the primary measure for health status in this chapter. In comparison to self-rated health, activity limitation status is a more objective health measure and it is less subjective and less vulnerable to historical changes in expectations. Each NHIS respondent was first asked what he/she was doing most of the past 12 months to indicate his/her major activities including "working", "keeping house", "going to school" and "something else". Then the respondent was asked if he/she was limited in the kind and amount of the major activities (depending on the answer to the last question). If yes, the respondent was asked whether the limitation was because of health and in what way activity was limited. NHIS integrated all of those questions into one recoded variable called activity limitation status. I further recoded this activity limitation status variable into two categories: any and no limitation so that the data are comparable across years.

Marital status is based on the survey question, "Are you now married, widowed, divorced, separated or never married?" Five categories of marital status are considered: married, widowed, divorced, separated, and never married, with the married as the reference group.

Period time is indicated by a variable identifying the survey year from 1983 (coded as 0) to 2003 (coded as 20).

Other socio-demographic covariates in the analysis include gender (female=1, male=0), race (non-Hispanic African American=1, non-Hispanic White=0), age (in one year units and centered at mean age of 48), and education (no high school diploma, high school graduate, some college, and college graduate with the last category as the reference group). All of these variables are potential confounders for the relationship between marital status and activity limitation status. About one percent of the observations have missing information on education and they are recoded at the mean value for the survey year. Because the marital association with health depends on age (Umberson et al. 2006), the estimated period trends will be biased if the age interaction is ignored (see Lynch 2003). In order to control for the potential age pattern of the marital differences in activity limitation status, I include interaction terms between age and marital status in my final models.

Similar to the analysis for self-rated health in Chapter 3, *family income* is also considered in the analysis for activity limitation status in this chapter. Family income serves as a potential mediator in the relationship between marital status and activity limitation status. I use the midpoint of each income category and then adjust them into 2003 U.S. dollars according to the consumer price index. I then use the logarithmic

transformation of family income to address the skewed income distribution (see Lynch 2006).

ANALYTIC DESIGN

I use logistic regression estimation for the conventional age-period-cohort model (with the cohort effect omitted). The model can be expressed in the following way:

$$\log \frac{p}{1-p} = \tau + \alpha T + \sum \beta_j M_j + \sum \gamma_j M_j T + \sum \pi_i X_i$$

Where p represents the probability of reporting any activity limitation status; τ represents the intercept; T is the period time variable and α is the coefficient; M_j represents the set of marital status dummy variables and β_j represents the corresponding coefficients ("married" is the reference group); γ_j represents the corresponding coefficients for the set of interaction terms between marital status and time; X_i stands for the other covariates included in the model and π_i for the corresponding coefficients. γ_j is of the most interest for this study as it reflects trends in activity limitation status differences by marital status.

Similar to the analysis for self-rated health, two models are estimated in the analysis for activity limitation status. In the first model, I examine trends in activity limitation status by marital status controlling only the basic socio-demographic covariates (i.e. age, gender, race, education and ageXmarital status). Results from Model 1 reflect the overall trends in the association between marital status and activity limitation status. I add family income in the second model to see how income may modify those trends. I run parallel regressions for women, men, African Americans and Whites to determine if historical trends differ on the basis of gender and race. Two-tailed t-tests are conducted to consider whether the differences in trends between subgroups are statistically significant.

DESCRIPTIVE RESULTS

Table 4.2 provides descriptive statistics for three selected survey years: 1983, 1993 and 2003. This table indicates that, over time, the proportion of married or widowed in the sample declined while the proportion of divorced and never married increased. The proportion separated showed a modest decline over time. For the married, the proportion having any activity limitation decreased over time; other marital status groups present non-linear changes in activity limitation status over the 1983-2003 period. For the widowed, divorced and never married, the proportion of having any activity limitation increased from 1983 to 1993 and then decreased from 1993 to 2003. For the separated, the proportion of having any activity limitation decreased between 1983 and 1993 and then increased between 1993 and 2003. For each marital status group, the proportion of college graduates generally increased over time. In this sample, the median family income decreased continually for the married group from 1983 to 2003, while it increased for the widowed or separated. For the divorced and never married, the median family income increased from 1983 to 1993 and then decreased from 1993 to 2003. Nevertheless, the married have the highest family income at all of the three time points.

The married and never married include a lower proportion reporting any activity limitation than do the divorced, separated or widowed, with the widowed having the highest proportion reporting any activity limitation. For each selected year, the never married include the highest proportion of college graduates followed by the currently married. The widowed, divorced and separated have relatively smaller proportions of college graduates with the widowed having the lowest proportion. As expected, the widowed are the oldest group while the never married are the youngest. The married

include a smaller proportion of African Americans than do other marital status groups. The widowed include the largest proportion of women among all marital status groups. These descriptive results are consistent with well-documented associations of as well as historical trends in marital status, education, health, gender, race, and marital status in the United States (U.S. Census Bureau 2006; Mirowsky and Ross 2003; Umberson and Williams 1999).

ESTIMATED TRENDS FROM LOGISTIC REGRESSION MODELS: TOTAL SAMPLE

Tables 4.3-4.5 show the estimated trends in activity limitation status by marital status from the weighted logistic regression models. Table 4.3 shows trends in activity limitation status by marital status for the total sample over the 1983 to 2003 period. Tables 4.4 and 4.5 indicate that there are some significant gender and race variations in trends and will be discussed in a later section. The first set of covariates in Tables 4.3-4.5 (i.e. YearXMarital Status) are of the greatest interest for this study because they reflect trends in activity limitation status by marital status. The main effect of "Year" indicates the trend for the married and the interaction terms of "Year" with other marital statuses represent the differences in activity limitation status trends between each specific marital status group and the married. The main effects of the marital status variables in Tables 4.3-4.5 reflect the initial level (i.e. at the beginning of the study period, 1983) of activity limitation status difference between the specific marital status groups and the married. Other covariates can be interpreted in the same way that coefficients in conventional regression models are interpreted.

Estimated effects of all of the covariates are in the expected directions. Specifically, the odds of reporting any activity limitation increase with age and they are smaller for women than for men. In comparison to Whites, African Americans are more

likely to have some limitations without controlling family income. However, when family income is held constant, African Americans are less likely to have some limitations than their White counterparts. In comparison to college graduates, each of the lower education groups exhibits higher odds of reporting an activity limitation.

Model 1 of Table 4.3 shows the estimated trends in activity limitation status differences by marital status for the total sample over the 1983 to 2003 period, net of the effects of age, ageXmarital status, gender, race, and education. I calculate the probability of reporting any activity limitation based on the results in Model 1 of Table 4.3. I illustrate the overall pattern of these results in Figure 4.1. These results indicate that, over the 1983 to 2003 period, the probability of reporting any activity limitation decreased among the married while it decreased at less rapid rates among the divorced and never married leading to divergent health gaps between the married and divorced or never married over time.

In contrast, over the past two decades, the probability of reporting any limitation increased among the separated and it remained stable among the widowed. Therefore, the difference in activity limitation status between the married and separated or widowed also widened over the 1983 to 2003 period. Over the entire study period, the widowed are the most likely to report any activity limitation among the marital status groups while the married are least likely to report any activity limitation. Moreover, differences in activity limitation status between the married and each of the unmarried groups—the widowed, divorced, separated and never married— widened over the 1983 to 2003 period.

I add family income as an additional covariate in Model 2 of Table 4.3 to see if and how family income contributes to activity limitation status trends between marital

status groups. Controlling family income results in little change in the activity limitation trend by marital status from Model 1 to Model 2 (shown in Table 4.3). These results suggest that marital status differences in family income do not explain divergent trends between the married and each of the unmarried groups—the widowed, divorced, separated, or never married.

GENDER AND RACE VARIATION IN ESTIMATED TRENDS FROM 1983 TO 2003

Tables 4.4 and 4.5 present the estimated trends in activity limitation status differences by marital status from the weighted logistic regression models for separate social groups. Both model estimation and two-tailed t-tests for group differences are presented in each table.

Gender

Table 4.4 shows the estimated trends in activity limitation status from 1983 to 2003 by marital status separately for women and men. Results from Model 1 of Table 4.4 are illustrated in Figure 4.2 and show that the probability of reporting any activity limitation status decreases over historical time for married women and it decreases at a more rapid rate for married men. Notably, the married remain less likely than any other marital status group to report any activity limitation for both men and women over the entire study period.

The divorced and never married also became increasingly less likely to report an activity limitation over time but at less rapid rates than the married, leading to divergence between the married and the divorced/never married over time. This is true for both men and women. Furthermore, this divergent trend in activity limitation status between the married and never married is significantly more pronounced for men than for women.

Gender differences in activity limitation status trends also emerge among the widowed. Over the twenty year period, the probability of reporting any activity limitation decreased modestly over time for widowed women but it increases for widowed men. For both women and men, the gap in activity limitation status between the married and widowed widened over time. Two-tailed t-test shows that the divergent trend in activity limitation status between the married and widowed is more profound for men than for women.

In contrast, the probability of reporting any activity limitation increased over time for separated women but it decreased modestly for separated men. Two-tailed t-test shows that this gender difference is not statistically significant. For both women and men, we see a widening gap in activity limitation status between the married and separated.

In Model 2 of Table 4.4, I add family income as an additional covariate; this results in little change in the estimated divergent trends in activity limitation status differences by marital status for either women or men. This suggests that family income inequality does not explain the trends in activity limitation status differences by marital status for either women or men.

Race

Table 4.5 compares the estimated trends in activity limitation status by marital status for Whites and African Americans. I illustrate the results from Model 1 of Table 4.5 in Figure 4.3. These results suggest that both married African Americans and married Whites exhibit a decrease in the probability of reporting any activity limitation over the twenty year period.

While the probability of reporting any activity limitation decreases for widowed and never married African Americans over the twenty year period, it remains stable for the widowed and never married Whites. For both racial groups, the divorced became less likely to report any activity limitation over time. Separated African Americans become less likely to report any activity limitation over time while separated Whites become increasingly more likely to report any activity limitation. Nevertheless, for both race groups, we see widening gaps between the married and each of the unmarried groups examined. Furthermore, two-tailed t-test shows that the divergent trend between the married and separated is more profound among Whites than African Americans.

I add family income as an additional covariate In Model 2 of Table 4.5. This results in little change in the estimated divergent trends in activity limitation status differences by marital status for either African Americans or Whites. This suggests that family income inequality does not explain the trends in activity limitation status differences by marital status for either African Americans or Whites.

SUMMARY

In this chapter, I investigated trends in activity limitation status by marital status using pooled data from the National Health Interview Survey from 1983 to 2003. The results from the logistic regression models show that:

1) Differences in activity limitation status between the married and each of the unmarried groups—including the widowed, divorced, separated and never married—have widened over the past two decades;

2) The trend toward a divergence in activity limitation status between the married and widowed/never married is more pronounced for men than for women;

3) The divergent trend between the married and separated is more pronounced for Whites than African Americans; and

4) Change in family income does not explain the divergent trends in activity limitation status by marital status.

Although activity limitation status is a relatively more objective measure for health status in comparison to self-rated health, this measure of activity limitation is self-reported by NHIS respondents and may reflect some subjective interpretations. In the next chapter, I turn to mortality as a measure of health status that is not influenced by subjective evaluation.

Chapter 5. Marital Status and Mortality 1986-2000

The marital advantage in longevity was detected as early as 1858 by William Farr in his study among the French population (Farr 1858). This issue caught increased scholarly and policy attention after Durkheim (1897) published his classic study on suicide in which he found that the married commit suicide less often than do unmarried individuals. In this chapter, I investigate marital status differences in mortality trends from 1986 to 2000 in the United States. In comparison to self-rated health and activity limitation status—both reported by the NHIS participants and potentially influenced by subjectivity by respondents—mortality is an objective measure of health and thus invulnerable to historical changes in expectations and interpretations.

DATA AND SAMPLE

Data are from the public-use version of the National Health Interview Survey Linked Mortality Files 1986-2000 (www.cdc.gov/nchs/r&d/nchs_datalinkage/nhis_data_linkage_mortality_activities.htm). Those mortality data are the linked files of the NHIS to the National Death Index (NDI) 1986-2000 with follow-up through December 31, 2002 (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2004). The public-use version of the data is similar to the restricted-use data but contains only a limited set of mortality variables (Lochner, Hummer, and Cox 2007). All NHIS participants are included in the linked mortality files, but only adult participants aged 18 and over were eligible for mortality follow-up (U.S. Dept. of Health and Human Services, National Center for Health Statistics 2004). A variable indicating eligibility status is provided on the files. The mortality data supply vital status, date of death for those who died and cause of death

information for those who died among eligible persons included in the NHIS for the years 1986 through 2000.

Only the adult samples aged 18 and over who were eligible for the mortality follow-up are included in the analyses. Additional analyses (not shown in the dissertation) restricting samples to ages 25 and above or ages 25-84 reveal similar patterns. I restrict the analyses to those who are identified as non-Hispanic White or African American. Individuals from other racial and ethnic groups are dropped from the analysis because of their tremendous heterogeneity. I further exclude cohabiting respondents from the analyses, who account for around one percent of the sample, because the NHIS did not collect information on cohabiting status prior to 1997. Missing cases on marital status when the surveys were conducted are also excluded. The total number of observations for the study across the 15 years of baseline data is 912,757. Among those participants, 110,973 of them were determined to have died during the follow-up period. Weights are applied in the analysis to adjust for the complex sampling frame of NHIS. All significance tests are based on robust standard errors, which are further adjusted for the primary sampling unit and strata employed in the sampling design.

Table 5.1 presents descriptive information on the composition for the total sample analyzed and shows that about 64 percent of the total sample is currently married at the time of the survey. The widowed and divorced each account for nearly eight percent of the sample. About two percent of the sample is separated and about eighteen percent is never married. The mean age at survey of the sample is around 45 and more than half are women. Nearly thirteen percent of the sample is African American. In the total sample, about 18 percent have no high school diploma and about 38 percent are high school

graduates. Those with some college but less than four years of college account for almost 23 percent of the sample. College graduates account for about 21 percent.

Table 5.2 provides eight age-specific matrixes of survey year by follow-up year. Those matrixes are based on eight age groups when the surveys were conducted. Within each age-specific matrix, each row represents survey year in three-year units and each column represents a three-year mortality follow-up window (the last column is a two-year follow-up). Three numbers are included in each cell of the matrix: 1) number surviving l(x), which represents the number of persons from the original survey year who survive to the beginning of each follow-up year interval; 2) number dying d(x), which shows the number of persons who died within the specified follow-up year interval; and 3) d(x)/l(x), which is the proportion of deaths among those who are interviewed in the specific survey years and within the specified follow-up year interval.

Three patterns stand out from Table 5.2. First, the sample size within each cell is fairly large, even in the oldest groups (i.e. ages 90 and above) and there is a fairly sizable number of deaths in each cell. Second, deaths are more likely to occur during later follow-up years. This pattern is observed when we compare the cells within each row. For example, for those who are aged 18-29 at interview in 1986-1988, 0.12% of them died during 1986-1988, 0.33% died during 1989-1991, 0.38% died during 1992-1994, 0.39% died during 1995-1997, and 0.47% died during 1998-2000. The small decrease in the proportion of deaths that occurred in 2001-2002 (i.e. 0.37%) reflects the shorter follow-up duration of that interval. This increased proportion of deaths across follow-up years, partially if not fully, reflects the aging process for each age group. Third, the proportion of deaths increases across age groups by comparing cells across the eight age-specific matrixes. For example, the proportion of deaths during the follow-up period of

1995-1997 is 0.39% for the group who are interviewed during1986-1988 and aged 18-29 at that time. This proportion increased to 41.06% for their peers aged 90 and above at interview.

VARIABLES

The outcome variable for this study is survival status indicating the risk of death for participants from the date when the survey was conducted through the follow-up end date of December 31, 2002. For those who died within this observation window, mortality status is coded as 1. For those who survive the follow-up period, mortality status is coded as 0 and the date of death is right censored.

The main variable adopted in this study to document the mortality trend is survey year cohort and will be discussed in more detail in the "Analysis Strategy" section. The survey year cohort is coded as 0 for those who were interviewed in 1986, 1 for those who were interviewed in 1987, 2 for those who were interviewed in 1988 and so on.

Marital status is based on the survey question, "Are you now married, widowed, divorced, separated or never married?" Five categories of marital status are considered: married, widowed, divorced, separated, and never married, with "married" as the reference group.

Other socio-demographic covariates in the analysis include gender (female=1, male=0), race (non-Hispanic African American=1, non-Hispanic White=0), age at survey (in one year units and centered at the mean age of 45), and education (no high school diploma, high school graduate, some college, and college graduate with the last category as the reference group). The NHIS top coding for age at survey is 99 for interviews conducted in 1995 and before, 90 in 1996 and 85 in 1997 and afterward. I calculate these truncated ages due to top coding using survey year minus reported birth year. About one

percent of observations have missing information on education and they are recoded to the mean value for the survey year. Family income is also considered in the analysis as a potential mediator for marital status-health trends. Because controlling family income results in no change in the pattern of mortality trends by marital status, I did not report the related results in the chapter.

ANALYSIS STRATEGY

Most previous studies (e.g. Feldman et al. 1989; Pappas et al. 1993; Preston and Elo 1995; Lauderdale 2001) of social differences in U.S adult mortality trends focus on educational differences and they compare mortality rates between two or several time periods/cohorts. The NHIS Linked Mortality Files provides unique opportunities for researchers to analyze mortality trend across continuous survey years/cohorts. In this chapter, I examine mortality trends by marital status across continuous survey year cohorts. NHIS participants are interviewed every year. Those who are interviewed in the same calendar year comprise one survey cohort, whose survival statuses are observed from the same calendar year when the survey was conducted through the follow-up until December 31, 2002. People in the same cohort go through the same mortality follow-up period and they experience the same environmental and social changes.

Figure 5.1 illustrates the survey year cohort structure of the NHIS Linked Mortality files. Each horizontal line in Figure 5.1 represents one survey year cohort. For example, in Figure 5.1 those who were interviewed in 1986 entered the observation window from 1986 when the survey was conducted and their survival statuses are followed up until December 31, 2002. I define this group as the 1986 survey year cohort. The 1986 NHIS sample— representing the civilian noninstitutionalized U.S. population of 1986—thus comprises the denominator of mortality risk for the 1986 survey cohort.

The other survey year cohorts are similarly defined. These NHIS linked mortality data cover 15 survey year cohorts from 1986 to 2000 and the follow-up time spans as long as 17 calendar years from 1986 to 2002. In this study I compare mortality risks across these survey year cohorts, which indicate changes in mortality risks of the representative adult U.S. population across survey years. The survey year cohort serves as the main variable to document mortality trends in this chapter.

Because I am concerned about the different duration of exposure in the observation window for different survey year cohorts, I conducted sensitivity tests by cutting the follow up duration into two years for each survey year cohort. The structure of the truncated data is illustrated in Figure 5.2. This analysis reveals results similar to those obtained using the full duration follow-up information, but loses statistical power because fewer deaths are observed in the truncated data. Two-year mortality follow-up also lowers the changes of marital transitions. In this chapter I report both results.

I start with descriptive analysis of marital status differences in mortality risk for four selected single survey year cohorts, i.e. 1986, 1990, 1995 and 2000. Then I estimate Cox proportional hazards models to better understand trends in the relationship between marital status and mortality, which can be specified as:

$$\log \frac{h_i(t)}{h_0(t)} = \alpha T + \sum \beta_j M_j + \sum \gamma_j M_j T + \sum \pi_k X_k$$

where t represents participants' age. $h_i(t)$ is the resultant death hazard at age t and $h_0(t)$ is the baseline hazard. This baseline hazard varies with t (i.e. age) and is indeed a hazard curve with age. T represents the survey cohort and α is the coefficient; M_j represents the set of marital status dummy variables and β_j represents the corresponding coefficients ("married" is the reference group); γ_j represents the corresponding coefficients for the set of interaction terms between marital status and survey cohort; X_k stands for the other

covariates included in the model (i.e. age at survey, gender, race and education) and π_k for the corresponding coefficients. γ_j is of greatest interest for this study because it reflects trends in mortality differences by marital status. Three-way interactions, i.e. cohortXmarital statusXgender and cohortXmarital statusXrace are added into the model when considering gender and race variations in mortality trends.

I use participant's age (in one year units) as the time metric to record death, which is indicated by *t* in the above equation. Using age as the analysis time is helpful to control the effects of age on other estimates (see Singer and Willett 2003). Participants are interviewed at different ages so they enter the observation window and risk set at different ages. This late entry problem is adjusted by restricting each participant's risk interval to start from their ages when the survey was conducted to their ages at death or censoring. For example, person A was interviewed in 1989 at age 65 and died in 1997 at age 73. The time exposure (i.e. *t*) of person A in the observation window is from age 65 to age 73. Person B was interviewed in 1995 at age 29 and survived to the date of December 31, 2002 when he/she was 36. The time exposure (i.e. *t*) of person B in the observation widow is from age 29 to age 36.

Although no assumptions are made about the shape of the underlying hazard function, the Cox proportional hazards model assumes that the ratio of the estimated hazards over analysis time (i.e. age in this case) is constant for those individuals with particular values for the covariates (Singer and Willett 2003). This proportional hazards assumption is tested and none of the covariates analyzed violates this proportionality assumption. Results for the proportionality tests based on scaled Schoenfeld residuals are shown in Table 5.3. Table 5.3 shows the results for investigating the proportional hazards assumption using the STATA STPHTEST command. The insignificant results indicate

that none of those variables analyzed violate this assumption. Figure 5.3 shows the –ln(-ln(survival probability)) across analysis time (i.e. age) for each marital status group. The relative parallel pattern between the lines in Figure 5.3 indicates no evidence for violation of the proportional hazards assumption for the marital status variable. Figures for the examination of other covariates are similar and not shown.

DESCRIPTIVE RESULTS

Table 5.4 provides descriptive statistics for two survey year cohorts: 1986 and 2000. This table indicates that the proportion of the married, and to a lesser extent the widowed or separated in the sample, declines while the proportion of the divorced or never married increases from survey cohort 1986 to 2000. The proportion who died from the time when the survey was conducted to December 31, 2002 is smaller for the 2000 cohort than for the 1986 cohort for each marital status group. This is at least partially because of the shorter mortality follow-up period for the 2000 cohort relative to the 1986 cohort. For each marital status group, the proportion of college graduates increases from survey cohort 1986 to 2000. The married have the largest proportion of college graduates while the widowed have the lowest proportion of college graduates. As expected, the widowed are the oldest group while the never married are the youngest. The widowed include the largest proportion of women among all marital status groups. The married include a smaller proportion of African Americans than do other marital status groups.

To understand trends in mortality differences by marital status, I begin by reporting descriptive results by marital status for four selected single survey cohorts: 1986, 1990, 1995 and 2000. Figure 5.4 displays the Kaplan-Meier survival curves by marital status for the selected survey cohorts. From Figure 5.4, we can see that gaps in survival curves between marital status groups are wider for the 2000 and 1995 survey

cohorts than the 1986 and 1990 survey cohorts. For all of the four survey cohorts, the married enjoy a survival advantage over each of the unmarried groups as shown by the less steep decline in survival curves with age. Figure 5.5 shows the Nelson-Aalen cumulative hazard curves by marital status and survey year cohort and presents a similar pattern of wider mortality gaps by marital status in the recent two survey cohorts than the earlier two. To better understand mortality trends by marital status, I next turn to results from the Cox proportional hazards models.

RESULTS FROM COX PROPORTIONAL HAZARDS MODELS

Table 5.5 presents the regression coefficients from Cox proportional hazards models based on data with full mortality follow-up information illustrated in Figure 5.1. Table 5.6 shows the results from Cox hazards models based on the truncated data with two-year mortality follow-up illustrated in Figure 5.2. For interpretation, the hazard ratios can be derived from the reported coefficients by exponentiation. Results in Table 5.5 and 5.6 reveal similar patterns in mortality trends by marital status, although results in Table 5.6 lose some statistical power because fewer deaths are observed in the truncated data. Here, I discuss the results reported in Table 5.5 with the full mortality follow-up information. Results controlling family income (not shown here) reveal similar patterns.

Model A of Table 5.5 shows the general pattern of marital status differences in mortality, net of the effects of basic socio-demographic covariates but without considering the differences across survey year cohorts. Results from Model A of Table 5.5 show that, on average, the married have lower mortality risk than each of the unmarried groups including the widowed, divorced, separated and never married. This is consistent with the well-known relationships between marital status and mortality (Waite 1995; Rogers, Hummer and Nam 2000).

Model B, C and D of Table 5.5 show the estimated mortality trends by marital status across survey year cohorts from the Cox proportional hazards models. Model B of Table 5.5 shows mortality trends by marital status for the total sample across the 1986-2000 survey cohorts. Model C and D of Table 5.5 present the results including gender and race interactions. The first set of covariates in Model B, C and D of Table 5.5 (i.e. the main effect of marital status variables) indicate the mortality difference between the specific marital status group and married persons for the baseline survey cohort (i.e. 1986 survey cohort). The second set of covariates in Model B, C and D (i.e. CohortXMarital Status) reflect marital status differences in mortality trends across survey cohorts. The main effect of "Cohort" indicates the mortality trend for the married and the interaction terms of "Cohort" with other marital statuses represent the differences in mortality trend between each specific marital status group and the married. The gender and race interaction terms included in Models C and D reflect social group variation in mortality trends. Specifically, the two-way interactions of Marital StatusXGender/Race indicate how marital status differences in mortality risk vary across gender/race groups for the baseline, 1986 survey cohort. The two-way interaction of CohortXGender/Race reflects gender/race differences in mortality trends of the married. The three way interactions of CohortXMarital StatusXGender/Race reflect gender/race variation in mortality trends by martial status across survey cohorts. Other covariates can be interpreted in the same way that coefficients in conventional Cox proportional hazards models are interpreted.

Estimated effects of all of the covariates are in the expected directions. Specifically, mortality risk increases with age at interview. Note that the magnitude of the age effect on mortality is smaller than expected in the model because age is used as the analysis time metric in the Cox models and most of the age effect is absorbed by the

baseline hazard, which is a function of age (Singer and Willett 2003). Results also show that mortality risk is higher for African Americans compared to Whites and lower for women compared to men. In comparison to college graduates, each of the lower education groups exhibits a higher risk of death. All of the main effects of the marital status variables in Model B, C and D are significantly positive, suggesting that each of the unmarried groups—including the widowed, divorced, separated and never married—have higher mortality risk than the married in the baseline survey cohort (i.e. 1986 survey cohort) for the related reference group.

Marital Status-Mortality Trends for Total Sample

Model B of Table 5.5 shows the estimated trends in mortality differences by marital status for the total sample across the 1986-2000 survey cohorts, net of the effects of age, gender, race, and education. Based on the results from Model B of Table 5.5, I calculate hazard ratios for each marital status group across survey year cohorts and graphically present them in Figure 5.6. Those adjusted hazard ratios compare the estimated risk score with the baseline risk score and indicate the mortality risk of a specific marital status group across survey year cohorts. The baseline risk score represents the mortality risk of the reference group in the model (i.e. the married who are interviewed in 1986 and who are also college graduates and White male). The hazard ratio for the reference group is one as indicated in Figure 5.6. All comparisons of the adjusted hazard ratios in Figure 5.6 are compared to this reference group.

These results show that mortality risk decreases among the married across survey cohorts while it increases for each of the unmarried groups—including the widowed, divorced, separated and never married. The most rapid increase is among the separated—leading to a widening mortality gap between the married and each of the unmarried

groups across the 1986-2000 survey cohorts. In particular, mortality risk of the married decreases 0.30% (i.e. [1-exp(-0.003)]*100%) across each one survey year cohort. In contrast, the mortality risk of the widowed, divorced, separated and never married increased 0.50% (i.e. [exp(-0.003+0.008)-1]*100%), 0.70% (i.e. [exp(-0.003+0.010)-1]*100%), 2.33% (i.e. [exp(-0.003+0.026)-1]*100%), and 1.31% (i.e. [exp(-0.003+0.016)-1]*100%), respectively, across each one survey year cohort.

Gender and Race Variation

Model C and D of Table 5.5 present the estimated trends in mortality differences by marital status from the Cox proportional hazards models with potential gender and race variations considered.

Gender

Model C of Table 5.5 shows the estimated trends in mortality by marital status across survey cohorts 1986-2000, including gender interactions. Based on the results in Model C of Table 5.5, I calculate hazard ratios for each marital status and gender group across survey year cohorts and graphically present them in Figure 5.7. Those adjusted hazard ratios compare the estimated risk score with the baseline risk score. The baseline risk score in Model C represents the mortality risk of married men who are interviewed in 1986 (and who also are college graduates and White). All comparisons of the adjusted hazard ratios in Figure 5.7 are compared to this reference group.

These results show that the mortality trend for each marital status group follows a similar pattern for men and women as for the total sample. In particular, mortality risk decreases across survey cohorts for both married men and married women, while it increases for each of the unmarried groups for both men and women. Therefore, we see

widening mortality gaps between the married and each of the unmarried groups for both men and women.

Although there is no significant gender difference in *change* of mortality across survey cohorts, there are two significant gender differences in those mortality trends that are noteworthy. First, for all of the survey cohorts, women experience lower mortality risk than men for each marital status group. Second, a significant interaction effect of Never MarriedXWomen indicates that the mortality gap between the married and never married was larger for men than for women for the baseline survey cohort (i.e. 1986) and this gender difference remained stable across all survey cohorts. These gender differences in mortality are illustrated in Figure 5.7.

Race

Model D of Table 5.5 compares mortality trends by marital status for Whites and African Americans. Based on the results in Model D of Table 5.5, I calculate hazard ratios for each marital status and race group across survey year cohorts and graphically present them in Figure 5.8. Those adjusted hazard ratios compare the estimated risk score with the baseline risk score. The baseline risk score in Model D represents the mortality risk of married Whites who are interviewed in 1986 (and also are college graduates and male). All comparisons of the adjusted hazard ratios in Figure 5.8 are compared to this reference group.

These results show that mortality of each marital status group follows similar trends for African Americans and Whites because of a lack of statistical significance in the three-way interactions (i.e. CohortXMarital StatusXRace). In particular, mortality risk decreases across survey cohorts for both married African Americans and Whites. For both race groups, mortality risk of the divorced and separated declines across survey

cohorts at the same rate as their married counterparts—leading to stable gaps between the married and divorced/separated for both race groups. In contrast, mortality risk of the never married, and to a lesser extent the widowed, increases across survey cohorts—leading to widening gaps between the married and never married/widowed for both race groups.

Although there is no significant race difference in *change* of mortality risk across survey cohorts, some related race differences in mortality stand out in Model D of Table 5.5 (also illustrated in Figure 5.8). First, on average, African Americans are subject to higher mortality risk than their White counterparts. Second, marital status differences in mortality level depend on race (indicated by the significant interaction effects of MaritalStatusXBlack). Although each of the unmarried groups suffers higher mortality risk than the married for Whites, this is not the case for African Americans. Widowed African Americans actually have lower mortality risk than their married peers among the earlier survey cohorts, but this pattern reverses for the recent survey cohorts because of a decline in mortality risk among married African Americans together with an increased risk among widowed African Americans. Moreover, the mortality disadvantage of divorced African Americans relative to married African Americans is much smaller than for their White peers. In contrast, never married African Americans suffer much higher mortality risk than married African Americans. This difference between the never married and married is less pronounced among Whites. Due to a lack of significant three-way interactions (i.e. CohortXMarital StatusXRace), those race differences in mortality hold for all survey cohorts.

SUMMARY

In this chapter, I investigated trends in mortality by marital status using data from the public-use version of the National Health Interview Survey Linked Mortality Files 1986-2000. The results from Cox proportional hazards models show that:

1) Differences in mortality risk between the married and each of the unmarried groups—including the widowed, divorced, separated and never married— have widened across the 1986-2000 survey cohorts;

2) The mortality gap between the married and never married was consistently larger for men and African Americans than for women and Whites across the 1986-2000 survey cohorts;

3) The mortality gap between the married and widowed/divorced was consistently smaller for African Americans than for Whites across the 1986-2000 survey cohorts;

4) There is no gender or race variation in *changes* in the mortality gap by marital status; and

5) Change in family income does not explain mortality trends toward divergence by marital status.

Chapter 6. Discussion and Conclusion

The United States witnessed remarkable changes in marriage and the family during the last few decades. Americans are more likely to marry at older ages or even never get married now than ever before. They are more likely to experience marital dissolutions and be involved in intimate relationships other than marriage such as cohabitation and same-sex unions. While family scholars have debated the causes of those changes, the consequences of such changes are relatively understudied. This study addresses one facet of the implications of recent changes in marriage for Americans. Specifically, what are the implications of changing trends in marital status for population health in the United States? This dissertation investigates the changing relationship between marital status and health from the 1970s to the 2000s in the United States, a period of rapid social change. Although previous research reveals little about how the association between marital status and health has changed across historical time, rapid marriage and social changes may have modified the balance of the costs and benefits of marriage for health over time.

This study is very important because politicians and researchers continue to emphasize the value of marriage for health, but we know very little about how the relationships between marital status and health have changed over time. In the context of rapid marriage changes, is marriage still a "panacea" for health? Results from this study suggest that the relationship between marriage and health/mortality may have changed over time.

MARITAL STATUS AND HEALTH DIFFERENTIALS: THREE DECADES OF CHANGE

That the married are healthier and live longer than the unmarried receives substantial theoretical attention as well as empirical support (Ross, Mirowsky and Goldsteen 1990; Waite 1995; Umberson and Williams 1999). Recent changes in marriage and the family have challenged long-standing assumptions about marriage benefits to health and mortality. However, little research has attempted to ascertain whether the association between marital status and health is invariant across historical time in the context of rapid social change. Based on data from three decades of the National Health Interview Surveys and their Linked Mortality files, this study shows that marital status differences in self-rated health status, activity limitation status and mortality have changed substantially over the last few decades. For all of the three health outcomes examined, the relative advantages of the married over the formerly married (the divorced, separated, and widowed) have increased over time. While the self-rated health of the never-married becomes more similar to that of the married (especially for men), activity limitation status and mortality risk of the never married has worsened over time, relative to the married. I further show that changes in family income—one of the most often documented mechanisms linking between marital status and health—explains little of the trends in health differences by marital status. For each measure of health status, I find important gender and race variation in health trends by marital status and challenge some long-held assumptions about gender, marital status, and health.

The Married

The married are the only marital status group enjoying improvement in all of the three health outcomes (i.e. self-rated health status, activity limitation status and mortality) over the study period. In the context of overall improvement in population health and

well-being, it is not surprising to see that the married—the generally advantaged social group relative to other marital status groups—are better off over time. Indeed, many social factors may contribute to health improvement of the married during the last three decades. For example, recent public policies may be more beneficial to the married in order to encourage marriage— particularly among the poor and minority social groups; in the context of increasing geographic mobility, the married may obtain more benefits of network connections and social support through marriage; with a greater number of people staying outside of marriage, those who choose to get and remain married may be those who benefit most from marriage—this reinforced marriage selection process may intensify the advantage of the married over the unmarried groups. Moreover, with increases in life expectancy, average duration of marriage becomes longer and previous research shows that the benefits from marriage accumulate as duration of the union increases (Lillard and Waite 1995).

The Never Married

The never married exhibit the least consistent evidence on change in health status over the 1970s to the 2000s period. Over time, self-rated health has improved more rapidly for the never married than any of the other marital status groups examined. This leads to a convergence in self-rated heath between the never married and married over time, especially for men. The activity limitation status of the never married remains relatively stable over time. But because the married become less likely to report any activity limitation, there is a divergent trend in activity limitation status between the never married and married over time. The mortality gap between the never married and married also widened over time because mortality risk of the never married increased over time.

Therefore, it seems that results on health trends of the never married depend on the health outcomes examined. The inconsistent evidence for the never married is, to some extent, echoed in previous research. The never married comprise the most controversial group in previous studies on marriage benefits for health (Umberson and Williams 1999). While some studies suggest that the married seem to have better health than the never married (Ross 1995; Horwitz, White and Howell-White1996a), others suggest that the never-married and married are very similar in certain measures of well-being (Marks 1996).

The overall improvement in self-reports of health status for the never-married may partially reflects the improvements in their economic situation. Indeed, change in family income explains the closing gap in self-rated health between the never married and married for Whites but not for African Americans. In the NHIS sample analyzed, the ratio of median family income of never married Whites relative to married Whites increased from 0.68 in 1972 to 0.75 in 2003. Moreover, in 1972, about seven percent of the NHIS sample (aged 25 to 80) was never married; by 2003, this percentage doubled and about fourteen percent of the sample was never married. A greater number of people never marrying (or delaying marriage which in turn increases their exposure to the status of never marrying) suggests that the pressure to marry and stay married has become weaker over time. As alternatives to marriage, in the form of cohabitation, staying single, and gay/lesbian unions, become more common and socially acceptable among recent cohorts, potential friend networks and social connections may be more accessible to the never married (Hull 2006). These social changes may be associated with enhanced psychological well-being and, in turn, psychological well-being may have positive effects on individuals' self reports on health.

In comparison to self-rated health, activity limitation status and mortality may be slower in response to social changes. However, it is not clear why mortality risk of the never married has increased over time. It may be that some causes of death increase while others decrease over time. Analysis on cause-specific death is not only helpful in indentifying the specific causes of death which have increased for the never married, but also helpful in teasing out the reasons behind the increasing mortality risk for the never married, because of different roles of social, psychological and economic factors in affecting deaths from various causes. For example, deaths from lung cancer or cardiovascular diseases are more likely to be affected by social, behavioral and psychological factors than causes from leukemia and aleukemia. If the increased mortality risk of the never married relative to the married is mainly from causes largely unaffected by social factors such as leukemia and aleukemia, some selection mechanisms instead of causal mechanisms may play a role in these mortality trends.

The Widowed

The widowed exhibit the most precipitous declines in self-rated health over the 1972-2003 study period. The widowed were as likely as the married to report being in good health in 1972 but they were about seven percent less likely to report being in good health by 2003. The activity limitation status of the widowed remains relatively stable while their mortality risk increases over the recent decades. For all of the three examined health outcomes, the situation of the widowed is worse off, relative to their married peers, now than in the past. The health of the widowed—who are more likely to live in poverty and to receive government assistance—might be even worse were it not for gains in government sponsored insurance programs such as Medicare (Smith and Zick 1986; McGarry and Schoeni 2004).

Several reasons may explain the worsening situation of the widowed relative to the married. First, the emotional trauma of losing a spouse from a longer duration marriage might be stronger than that from a shorter duration marriage (Kulkarni 1986). Therefore, as average duration of marriage becomes longer with increases in life expectancy the stress associated with widowhood may increase further. Second, widowhood is occurring later in the life course and this may contribute to a more frail widowed population over time.

The Divorced/Separated

The self-rated health status of the divorced becomes worse over time, relative to the married, and their mortality risk also increases over time. The only indication of improvement for the divorced over time is change in activity limitation status. Over time, the divorced are less likely to report to have any activity limitation. However, in comparison to their married peers, the rate of decline in the probability of reporting any activity limitation is slower for the divorced. Therefore, gaps between the married and divorced widened over the study period for each of the three health outcomes examined.

The separated are the most disadvantaged marital status group in terms of change in health status over time. For all of the three health outcomes examined, the separated became worse off over time. They have experienced the most rapid increase in both mortality risk and reporting of activity limitations. Their self-rated health status also declined over time.

Recent research (Williams and Umberson 2004) suggests that the stress associated with divorce/separation is primarily responsible for health declines among the divorced/separated, but it is not clear why divorce/separation would be more detrimental to health (that is, more of a stressor) now than it was in the past. In the context of

increasing occurrences of divorce and separation, one would expect that being divorced or separated would carry less stigma and produce less stress. However, the present results do not reveal any evidence of a closing health gap between the married and divorced/separated over time.

Furthermore, the growing health disparity between the married and divorced/separated is not because of changes in family income. Indeed, the economic cost of marital dissolution, especially for women, has not changed substantially over recent decades, despite increasing opportunities for women outside of marriage (Smock 1993).

Over the past three decades, several aspects of social and economic status worsened in the United States—the cost of health insurance rose, health-care coverage declined, female-headed households increased and income inequality grew significantly. All of those factors create more social and economic barriers for the divorced. For example, access to health insurance as well as level of coverage for the insured has diminished significantly over the past several decades (DeNavas-Walt, Proctor, and Lee 2006). Getting divorced or separated significantly decreases one's chance of having health insurance (Berk and Taylor 1984). In this sense, marital dissolution may reduce one's access to insurance coverage and this cost may have become greater over time in the context of diminishing health insurance coverage and rising health-care costs. Another possibility for the growing health disparity between the divorced/separated and married is that in the context of increasing geographic mobility, getting divorced or separated from a spouse increases one's chance of disconnection from social networks and social support—perhaps more so now than in the past. In this sense, marriage may have become more important for health and marital dissolution may have become more detrimental to health.

Gender Variation

Since the early 1970s, sociologists have emphasized that marriage benefits the health of men more than women because of women's less rewarding/more demanding roles within marriage and the family (Bernard 1972; Gove 1972, 1973). The adverse effects of divorce on health also seem to be greater for men than for women (Williams and Umberson 2004). However, the argument that marriage benefits the health of men more than women has been, and continues to be, challenged and contested. This issue becomes more complicated when we consider changes in gender differences in the association of marital status with health over time.

Results for self-rated health status show that the divergent trend between the married and each of the previously married groups—including the widowed, divorced and separated—is more pronounced for women than for men and the convergent trend between the married and never married is true for men but not women. In the early 1970s, I do find larger health gaps between the married and unmarried for men than for women. However, over time, gender differences in the links between marital status and self-rated health status seem to have diminished over time.

In her blueprints for the future of marriage, Bernard (1972) describes the future of his and her marriage as "…a marriage in which the partners share domestic and provider roles…(p: xii)". She expects that "the future of marriage" in a "shared-role pattern" would diminish the difference in her and his gains from a marital union. My findings provide the evidence that Bernard's dream seems to have come true about three decades later in terms of diminishing gender differences in marriage benefits for self-rated health. Family scholars argue that women are more likely to provide emotional support to a spouse while men more likely to receive support from a spouse (Umberson 1992;

Erickson 2005). Over time, women have become more likely to work outside the home, their earnings have increased, they spend less time on housework when they work outside the home, and their husbands do a larger share of childcare than in the past. Therefore, men's role of breadwinnder and women's role of housewife within the household become more similar. Those changes in gender roles over time may have altered the gender distribution in marriage benefits for psychological well-being. Indeed, both Simon (2002) and Williams (2003) find that marriage benefits mental health equally for men and women using recent datasets. In turn, this may alter the gender distribution in marriage benefits for self-rated health.

In contrast, results from this study suggest that marriage still benefits men more than women in terms of lowering mortality risk and reducing the likelihood of reporting activity limitations. One possibility is that mortality and, to a lesser extent, activity limitation status are relatively more objective measures of health status in comparison to self-rated health or that they take longer to respond to social psychological changes. Indeed, self-rated health is a predictor of mortality and changes in self-rated health occur prior to changes in mortality. In addition, mortality and activity limitations are much more prevalent among older cohorts and thus they may be more likely to reflect the social inequality of older cohorts in comparison to recent cohorts.

These results indicate that gender variation in marital status-health trends depends on how we measure health status. These complex results, to some extent, are echoed in previous literature on gender differences in marital benefits to health. Although substantial previous research suggests that marriage benefits health more for men than for women (e.g. Gove 1973, Rogers 1995, Williams and Umberson 2004), this gender difference in the relationship between marriage and health is challenged by recent studies

using different measures of health. For example, recent studies on gender differences in the effects of marriage on mental health suggest that marriage benefits mental health equally for men and women (Simon 2002; Williams 2003). Other studies suggest that gender differences in the association between marital status and mortality are minimal (Lillard and Waite 1995, Hemstrom 1996). A recent study by Zhang and Hayward (2006) even finds that divorce results in a higher risk of cardiovascular disease in late midlife for women than for men. The inconsistent results from the present study highlight the complexity of this issue and challenge the longheld assumptions about gender, marital status and health. With rapid changes in gender roles, the notion that marriage benefits the health of men more than women and marital dissolution hurts the health of men more than women needs some qualification depending on historical time period as well as different measures of health status.

Nevertheless, the conclusions about gender differences in the benefit of marriage for health as well as changes in those gender differences over time are highly dependent on the measurements of health. Family scholars argue that women benefit more from the economic benefits of marriage whereas men benefit more from the social/emotional support and health regulation offered by marriage (Waite 1995). Over time, those benefits through marriage may have changed for both men and women.

Race Variation

In comparison to gender differences, race differences in marital status-health trends are more consistent. Over time, never married and married African Americans became increasingly similar in their self reports of health status and this convergence between the married and never married is much less pronounced among Whites. In contrast, separated Whites become more likely to report any activity limitation in

comparison to their married peers and this divergent trend between the married and separated is not statistically significant for African Americans. In sum, it appears that marriage may be less beneficial to African Americans' health than it used to be and that marital dissolution may be more detrimental to Whites' health than it used to be. Those racial differences in health trends by marital status are consistent with the hypothesis that health differentials by marital status are more likely to decrease and/or are less likely to increase among African Americans than Whites.

The more rapid convergence and less rapid divergence in health between the married and unmarried among African Americans than Whites may reflect the greater increase in the prevalence and social acceptance/support of being unmarried among African Americans compared to Whites. Therefore, staying outside of marriage is associated with more dampened stress and disadvantage for African Americans compared to Whites. It may also result from the diminishing negative criteria associated with selection into the unmarried group for African Americans with an increasing proportion of African Americans staying outside of marriage.

IMPLICATIONS FOR POPULATION HEALTH AND MARRIAGE POLICIES

Politicians and scholars continue to debate the value of marriage for Americans. Social programs and policies have been and perhaps will continue to be established to encourage marriage—especially among poor minority groups. These policies are based on the assumption that marriage improves individuals' well-being. In this study, I find an overall growing health disparity between the married and each of the unmarried groups examined —including the widowed, divorced, separated and never married. The only one exception is when I compare self-rated health between never married men and married men. Those results highlight the complexity of current marriage policy.

Mortality is one of the most important facets of population well-being and this study shows that mortality risk increases over time for each of the unmarried groups examined relative to the married. This suggests that the assumption of marriage promoting well-being is more salient now than ever before in terms of reducing mortality (and also activity limitation). In spite of a trend toward a retreat from formal marriage in the United States, marriage becomes more important over time, at least in terms of reducing mortality risk. On the other hand, the self-rated health status of never married men has improved more rapidly than that of married men over time. This challenges the general notion that marriage is a panacea for health and suggests that encouraging marriage in order to promote health may be misguided. In fact, getting married increases one's risk for eventual marital dissolution and marital dissolution seems to be worse for health and mortality now than in the past.

Results from this study also have important implications for population health. One of the goals of *Healthy People 2010* is to "eliminate health disparities" *(http://www.healthypeople.gov/).* However, this study shows that the United States is heading in the opposite direction in terms of marital status differences in health/mortality. This general growing health disparity by marital status raises concerns for population health. The unmarried groups are becoming more vulnerable in comparison to the married more so than ever before. In the context of overall improvement in population health and longevity, the married—who have already been advantaged—are better off while the unmarried—who have been disadvantaged are worse off. Special attention should be given to the increasing social inequality in health/mortality by marital status in order to achieve the general goal of enhancing population well-being. The unmarried groups, who represent a growing segment of the population, are becoming more

physically vulnerable now than in the past—which warrants special concern for population health. Future studies should seek to identify the mechanisms that explain this increased health disparity by marital status and implement social policies and interventions to improve health status and reduce mortality risk among the disadvantaged marital groups.

LIMITATIONS

This study is not without limitations. First, although the repeated cross-sectional data that I use in this study are a valuable resource for analyzing trends in the association between marital status and health across historical time, one of the most important limitations of this study is its inability to use those cross-sectional pooled data to assess the relative importance of the selection, crisis and protection explanations for the link between marital status and health (Goldman, 1993; Simon 2002). The marital resource model, stress model and selection model suggest that various social, biological, psychological, and behavioral mechanisms work together to determine trends in the association between marriage and health in the context of rapid social change. It is unclear which mechanisms play roles in deciding the changing relationships between marital status and health. Although I explored the role of family income in this study, readers should interpret these results with caution due to significant changes in family income coding for the NHIS from 1982-2003. Future studies should focus on trying to best understand the explanations behind health trends by marital status—especially trends toward widening disparities between the married and previously married. Teasing out those mechanisms which lead to changes in the marital relationship with health over time is helpful not only for designing social programs and policies aimed to eliminate this health disparity but also for better evaluating current marriage policies.

This study is also limited by lacks of controls for marital transitions, which are not available in the NHIS data. This problem is most relevant to the mortality analysis where the mortality follow-up spans up to 17 years. Moreover, the matching quality of the NHIS Linked Mortality Files is worse in recent years in comparison to earlier years. This may also bias the results on mortality trends.

CONCLUSIONS

The United States witnessed remarkable changes in marriage and the family during the last few decades, and these changes challenged longstanding assumptions about marriage benefits for health. However, little research has attempted to ascertain whether the association between marital status and health is invariant across historical time and in the context of rapid social change. This study shows that the link between marital status and health has changed substantially over the past three decades and these changes reflect rapid historic and ongoing changes in the institutions of marriage and the family in the United States. In the context of overall improvement in population health, some groups change for the better and others change for the worse. The health gap between the married and unmarried—especially the previously married, which represent a growing segment of the population—has widened over the past three decades. These growing health disparities between marital status groups deserve more scholarly and policy attention in order to achieve a more equitable distribution of health for all social groups as well as better health for the overall population.

Tables

Table 3.1. Sample Composition for Analyzing Self-Rated Health (Pooled NHIS 1972-2003)

	Mean	S.D.
Age	48.32	15.56
		Percentage
Marital Status		
Married		67.18
Widowed		10.58
Divorced		9.31
Separated		3.04
Never married		9.89
Total		100.00
Gender		
Men		35.17
Women		64.83
Total		100.00
Race		
Whites		88.89
African Americans		11.11
Total		100.00
Education		
No High School Diploma		29.11
High School Graduate		36.53
Some College		17.14
College Graduate		17.22
Total		100.00
		Median
Family income[a]		40421.79
N		1119266

a. Family income reported in this table is adjusted based on 2003 dollars.

Table 3.2. Weighted Descriptive Characteristics by Marital Status for Selected Years (NHIS 1972-2003 Sample)

		1972	1987	2003
Married	Proportion of Total Sample	72.46	65.68	58.41
	Excellent/good Heath (%)	82.94	86.85	89.98
	College Graduate (%)	10.70	19.26	30.84
	Mean Age	46.72	47.25	48.92
	Women (%)	67.51	61.24	59.09
	African Americans (%)	7.23	8.15	8.76
	Median of Family Income[a]	55023.92	48591.55	40000.00
Widowed	Proportion of Total Sample	11.90	10.05	8.87
	Excellent/good Heath (%)	72.08	72.17	76.20
	College Graduate (%)	5.27	8.46	13.46
	Mean Age	64.87	67.35	68.09
	Women (%)	84.73	85.18	83.33
	African Americans (%)	13.20	13.21	14.35
	Median of Family Income	15406.70	23485.92	30000.00
Divorced	Proportion of Total Sample	5.48	10.68	15.47
	Excellent/good Heath (%)	80.39	84.86	83.15
	College Graduate (%)	9.90	18.27	22.92
	Mean Age	46.35	45.36	50.37
	Women (%)	64.17	63.07	59.74
	African Americans (%)	13.88	14.61	16.24
	Median of Family Income	28612.44	31584.51	30000.00
Separated	Proportion of Total Sample	3.02	2.89	2.83
	Excellent/good Heath (%)	71.71	79.53	78.32
	College Graduate (%)	6.25	12.68	14.46
	Mean Age	43.57	41.59	45.41
	Women (%)	64.51	66.48	63.19
	African Americans (%)	40.49	36.43	37.09
	Median of Family Income	19808.61	25105.63	30000.00
Never Married	Proportion of Total Sample	7.14	10.70	14.41
	Excellent/good Heath (%)	82.94	90.30	88.28
	College Graduate (%)	25.65	34.18	35.53
	Mean Age	45.31	37.73	40.00
	Women (%)	51.12	49.25	49.14
	African Americans (%)	13.72	19.38	26.20
	Median of Family Income	28612.44	36443.66	30000.00

a. Family income reported in this table is adjusted based on 2003 dollars.

Table 3.3. Trends in Marital Status Differences in Self-Rated Health from Ordered Logistic Regression Models, 1972-2003 (age 25-80)

	Model 1	Model 2
YearXMaritial Status(0=Married)		
Year	0.003***	0.009***
YearXWidowed	-0.023***	-0.028***
YearXDivorced	-0.008***	-0.012***
YearXSeparated	-0.008***	-0.010***
YearXNeverMarried	0.004***	0.002*
Marital Status(0=Married)		
Widowed	-0.013	0.250***
Divorced	-0.026	0.269***
Separated	-0.202***	0.110***
Never Married	-0.158**	0.138***
Basic Demographic Variables		
Age	-0.029***	-0.026***
AgeXWidowed	0.023***	0.025***
AgeXDivorced	0.004***	0.003***
AgeXSeparated	0.002	-0.001
AgeXNeverMarried	0.008***	0.005***
Women	-0.041***	-0.009
African Americans	-0.576***	-0.476***
Education (0=College Graduate)		
No High School Diploma	-1.514***	-1.224***
High School Graduate	-0.779***	-0.636***
Some College	-0.429***	-0.348***
Survey since 1982	0.555***	0.497***
Log of family income	---	0.474***
Cut1	-4.077	1.131
Cut2	-2.480	2.759
Cut3	-0.572	4.705
Pseudo R2	0.081	0.091
N	1119266	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.

Table 3.4. Trends in Marital Status Differences in Self-Rated Health by Gender from Ordered Logistic Regression Models, 1972-2003 (age 25-80)

	Model 1			Model 2		
	Women	Men	m≠w	Women	Men	m≠w
YearXMaritial Status(0=Married)						
Year	0.005***	-0.001	†††	0.012***	0.004***	†††
YearXWidowed	-0.024***	-0.019***	††	-0.030***	-0.023***	†††
YearXDivorced	-0.010***	-0.005***	††	-0.014***	-0.006***	†††
YearXSeparated	-0.008***	-0.007**		-0.011***	-0.008***	
YearXNeverMarried	0.000	0.009***	†††	-0.002	0.008***	†††
Marital Status(0=Married)						
Widowed	0.016	-0.092*	††	0.295***	0.060	†††
Divorced	0.011	-0.091***	†††	0.339***	0.128***	†††
Separated	-0.255***	-0.081*	†††	0.083**	0.158***	
Never Married	-0.052**	-0.315***	†††	0.249***	-0.027	†††
Sociodemographic Variables						
Age	-0.029***	-0.030***	†††	-0.026***	-0.027***	††
AgeXWidowed	0.023***	0.021***		0.025***	0.026***	
AgeXDivorced	0.007***	-0.001	†††	0.005***	0.000	†††
AgeXSeparated	0.004**	-0.006***	†††	0.000	-0.005**	†
AgeXNeverMarried	0.011***	0.003***	†††	0.008***	0.001	†††
African Americans	-0.695***	-0.351***	†††	-0.599***	-0.251***	†††
Education (0=College Graduate)						
No High School Diploma	-1.550***	-1.433***	†††	-1.261***	-1.137***	†††
High School Graduate	-0.770***	-0.796***		-0.623***	-0.653***	†
Some College	-0.409***	-0.464***	†††	-0.329***	-0.377***	††
Survey since 1982	0.538***	0.586***	††	0.478***	0.534***	†††
Log of family income	---	---		0.453***	0.512***	†††
Cut1	-4.184	-3.838		0.790	1.740	
Cut2	-2.475	-2.413		2.526	3.201	
Cut3	-0.503	-0.618		4.533	5.038	
Pseudo R2	0.080***	0.083		0.090	0.096	
N	722695	396571		722695	396571	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.
Two-tailed tests for group differences: †††p<0.001; ††p<0.01; †p<0.05

Table 3.5. Trends in Marital Status Differences in Self-Rated Health by Race from Ordered Logistic Regression Models, 1972-2003 (age 25-80)

	Model 1			Model 2		
	NH Black	NH White	b≠w	NH Black	NH White	b≠w
YearXMaritial Status(0=Married)						
Year	0.011***	0.002**	†††	0.014***	0.008***	†††
YearXWidowed	-0.023***	-0.022***		-0.028***	-0.027***	
YearXDivorced	-0.005**	-0.008***		-0.008***	-0.012***	
YearXSeparated	-0.004	-0.009***		-0.005*	-0.011***	
YearXNeverMarried	0.008***	0.003**	†	0.007***	0.001	††
Marital Status(0=Married)						
Widowed	-0.030	0.004		0.206***	0.266***	
Divorced	0.003	-0.028		0.234***	0.279***	
Separated	-0.222***	-0.186***		0.022	0.134***	
Never Married	-0.247***	-0.149***	†	0.004	0.151***	†††
Sociodemographic Variables						
Age	-0.033***	-0.029***	†††	-0.031***	-0.026***	†††
AgeXWidowed	0.028***	0.022***	††	0.030***	0.024***	†
AgeXDivorced	0.008***	0.004***	††	0.008***	0.002**	†††
AgeXSeparated	0.004*	0.001		0.003	-0.002	
AgeXNeverMarried	0.002	0.009***	†††	0.000	0.006***	†††
Women	-0.330***	-0.002	†††	-0.282***	0.027***	†††
Education (0=College Graduate)						
No High School Diploma	-1.358***	-1.542***	†††	-1.045***	-1.252***	†††
High School Graduate	-0.804***	-0.784***		-0.611***	-0.644***	
Some College	-0.447***	-0.433***		-0.335***	-0.353***	
Survey since 1982	0.333***	0.587***	†††	0.315***	0.522***	†††
Log of family income	---	---		0.385***	0.491***	†††
Cut1	-3.534	-4.083		0.690	1.302	
Cut2	-1.910	-2.488		2.343	2.926	
Cut3	-0.182	-0.551		4.101	4.903	
Pseudo R2	0.069	0.078		0.078	0.088	
N	144044	975222		144044	975222	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.
Two-tailed tests for group differences: †††p<0.001; ††p<0.01; †p<0.05

Table 4.1. Sample Composition for the Analysis of Activity Limitation Status (Pooled NHIS 1983-2003)

	Mean	S.D.
Age	48.39	15.49
		Percentage
Marital Status		
Married		63.12
Widowed		9.56
Divorced		12.23
Separated		2.92
Never married		12.18
Total		100.00
Gender		
Men		38.20
Women		61.80
Total		100.00
Race		
Whites		87.72
African Americans		12.28
Total		100.00
Education		
No High School Diploma		18.11
High School Graduate		36.44
Some College		22.60
College Graduate		22.85
Total		
		Median
Family income[a]		39344.26
N		689922

a. Family income reported in this table is adjusted based on 2003 Dollars.

Table 4.2. Weighted Descriptive Characteristics by Marital Status for Selected Years (NHIS 1983-2003 Sample)

		1983	1993	2003
Married	Proportion of Total Sample	66.45	64.41	58.48
	Any Activity Limitation (%)	19.54	19.34	13.49
	College Graduate (%)	17.06	22.85	30.70
	Mean Age	47.18	47.66	48.91
	Women (%)	0.63	0.59	0.59
	African Americans (%)	0.07	0.08	0.09
	Median of Family Income[a]	50803.21	41384.08	40000
Widowed	Proportion of Total Sample	10.62	9.09	8.87
	Any Activity Limitation (%)	36.60	38.49	33.53
	College Graduate (%)	7.51	9.03	13.40
	Mean Age	67.00	68.35	68.09
	Women (%)	0.86	0.83	0.83
	African Americans (%)	0.14	0.14	0.14
	Median of Family Income	19397.59	24830.45	30000
Divorced	Proportion of Total Sample	9.96	11.92	15.44
	Any Activity Limitation (%)	23.19	25.51	23.63
	College Graduate (%)	16.50	20.63	22.87
	Mean Age	44.48	47.22	50.38
	Women (%)	0.64	0.63	0.60
	African Americans (%)	0.15	0.17	0.16
	Median of Family Income	28634.54	35017.3	30000
Separated	Proportion of Total Sample	2.99	2.68	2.82
	Any Activity Limitation (%)	25.78	23.51	24.17
	College Graduate (%)	11.86	15.26	14.43
	Mean Age	42.03	43.08	45.39
	Women (%)	0.64	0.62	0.63
	African Americans (%)	0.41	0.35	0.37
	Median of Family Income	21244.98	28650.52	30000
Never Married	Proportion of Total Sample	9.98	11.89	14.39
	Any Activity Limitation (%)	17.19	20.75	16.82
	College Graduate (%)	33.33	35.12	35.45
	Mean Age	38.52	38.46	40.00
	Women (%)	0.50	0.48	0.49
	African Americans (%)	0.19	0.23	0.26
	Median of Family Income	30481.93	35017.3	30000

a. Family income reported in this table is adjusted based on 2003 Dollars.

Table 4.3. Trends in Marital Status Differences in Activity Limitation Status from Logistic Regression Models 1983-2003 (age 25-80)

	Model 1	Model 2
YearXMaritial Status(0=Married)		
Year	-0.018***	-0.023***
YearXWidowed	0.018***	0.019***
YearXDivorced	0.014***	0.018***
YearXSeparated	0.022***	0.025***
YearXNeverMarried	0.017***	0.020***
Marital Status(0=Married)		
Widowed	0.295***	0.037
Divorced	0.208***	-0.143***
Separated	0.153*	-0.250***
Never Married	0.100*	-0.290***
Basic Demographic Variables		
Age	0.039***	0.036***
AgeXWidowed	-0.023***	-0.023***
AgeXDivorced	0.001	0.003***
AgeXSeparated	0.008***	0.012***
AgeXNeverMarried	-0.002*	0.002*
Women	-0.085***	-0.130***
African Americans	0.087***	-0.035***
Education (0=College Graduate)		
No High School Diploma	1.074***	0.680***
High School Graduate	0.488***	0.268***
Some College	0.426***	0.302***
Log of family income	---	-0.564***
Constant	-1.792***	4.509***
Pseudo R2	0.092	0.113
N	689922	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.

Table 4.4 Trends in Marital Status Differences in Activity Limitation Status by Gender from Logistic Regression Models 1983-2003 (age 25-80)

	Model 1			Model 2		
	Women	Men	m≠w	Women	Men	m≠w
YearXMaritial Status(0=Married)						
Year	-0.014***	-0.024***	†††	-0.019***	-0.028***	†††
YearXWidowed	0.013***	0.026***	††	0.015***	0.027***	††
YearXDivorced	0.013***	0.015***		0.018***	0.015***	
YearXSeparated	0.022***	0.022***		0.026***	0.022***	
YearXNeverMarried	0.013***	0.022***	†	0.017***	0.023***	
Marital Status(0=Married)						
Widowed	0.422***	-0.021	†††	0.164***	-0.220*	†††
Divorced	0.269***	0.123*		-0.105*	-0.147*	
Separated	0.264***	-0.023	†	-0.159	-0.325**	
Never Married	0.196***	-0.034	††	-0.200***	-0.424***	†
Sociodemographic Variables						
Age	0.039***	0.038***		0.036***	0.035***	
AgeXWidowed	-0.024***	-0.022***		-0.023***	-0.023***	
AgeXDivorced	-0.000	0.003*	†	0.002*	0.003*	
AgeXSeparated	0.008***	0.011***		0.014***	0.011***	
AgeXNeverMarried	-0.003***	0.000	†	0.001	0.003*	
African Americans	0.099***	0.050**	†	-0.008	-0.084***	†††
Education (0=College Graduate)						
No High School Diploma	1.038***	1.112***	††	0.671***	0.675***	
High School Graduate	0.437***	0.559***	†††	0.227***	0.317***	†††
Some College	0.377***	0.485***	†††	0.258***	0.349***	†††
Log of family income	---	---		-0.502***	-0.664***	†††
Constant	-1.941***	-1.685***	†††	3.675***	5.667***	†††
Pseudo R2	0.093	0.091		0.110	0.118	
N	435222	254700		435222	254700	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.
Two-tailed tests for group differences: †††p<0.001; ††p<0.01; †p<0.05

Table 4.5. Trends in Marital Status Differences in Activity Limitation Status by Race from Logistic Regression Models 1983-2003 (age 25-80)

	Model 1			Model 2		
	NH Black	NH White	b≠w	NH Black	NH White	b≠w
YearXMaritial Status(0=Married)						
Year	-0.018***	-0.018***		-0.019***	-0.023***	
YearXWidowed	0.014***	0.018***		0.015***	0.019***	
YearXDivorced	0.012**	0.015***		0.014**	0.018***	
YearXSeparated	0.010	0.030***	†	0.012*	0.031***	
YearXNeverMarried	0.013**	0.018***		0.015***	0.021***	
Marital Status(0=Married)						
Widowed	0.426***	0.253***		0.184	-0.002	
Divorced	0.165	0.210***		-0.125	-0.149***	
Separated	0.350**	-0.012		-0.027	-0.373***	
Never Married	0.210*	0.082		-0.168	-0.291***	
Sociodemographic Variables						
Age	0.045***	0.038***	†††	0.044***	0.035***	†††
AgeXWidowed	-0.027***	-0.022***		-0.026***	-0.023***	
AgeXDivorced	-0.002	0.001		-0.001	0.003**	
AgeXSeparated	0.004	0.007***		0.007**	0.011***	
AgeXNeverMarried	0.007***	-0.005***	†††	0.012***	-0.002*	†††
Women	-0.014	-0.090***	†††	-0.078***	-0.130***	†
Education (0=College Graduate)						
No High School Diploma	1.316***	1.048***	†††	0.871***	0.657***	†††
High School Graduate	0.711***	0.478***	†††	0.422***	0.263***	†††
Some College	0.584***	0.422***	†††	0.417***	0.302***	†††
Log of family income	---	---		-0.522***	-0.577***	†††
Constant	-1.941***	-1.776***	††	3.817***	4.664***	†††
Pseudo R2	0.124	0.087		0.149	0.107	
N	102407	587515		102407	587515	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.
Two-tailed tests for group differences: †††p<0.001; ††p<0.01; †p<0.05

Table 5.1. Descriptive Characteristics of Sample Composition Analyzed (Pooled NHIS 1986-2000)

	Mean	S.D.
Age at survey	45.13	17.82
Marital Status		Percent
Married		64.15
Widowed		7.52
Divorced		7.79
Separated		2.02
Never married		18.52
Total		100.00
Gender		
Men		47.53
Women		52.47
Total		100.00
Race		
Whites		87.49
African Americans		12.51
Total		
Education		
No High School Diploma		18.16
High School Graduate		37.66
Some College		23.03
College Graduate		21.15
Total		100.00
N		912757

Table 5.2. Mortality Rate by Survey Cohort, Follow-Up Year, and Age in the NHIS-NDI, 1986-2002

l(x) d(x) d(x)/l(x)	**Follow-Up Years**																					
Survey Cohorts	**Age at survey18-29**						**Age at survey 30-39**						**Age at survey 40-49**						**Age at survey 50-59**					
	86-88	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**
86-88	48541	48482	48322	48140	47951	47727	42695	42592	42343	42057	41740	41343	31809	31662	31329	30885	30343	29665	25172	24914	24188	23299	22298	21151
	59	160	182	189	224	176	103	249	286	317	397	327	147	333	444	542	678	530	258	726	889	1001	1147	935
	.0012	.0033	.0038	.0039	.0047	.0037	.0024	.0058	.0068	.0075	.0095	.0079	.0046	.0105	.0142	.0175	.0223	.0179	.0102	.0291	.0368	.0430	.0514	.0442
89-91	---	51002	50929	50734	50581	50410	---	50161	50025	49759	49424	49044	---	39771	39603	39137	38610	37937	---	28737	28422	27649	26729	25622
	---	73	195	153	171	142	---	136	266	335	380	309	---	168	466	527	673	537	---	315	773	920	1107	866
	---	.0014	.0038	.0030	.0034	.0028	---	.0027	.0053	.0067	.0077	.0063	---	.0042	.0118	.0135	.0174	.0142	---	.0110	.0272	.0333	.0414	.0338
92-94	---	---	44681	44588	44448	44307	---	---	48194	48079	47830	47533	---	---	40913	40721	40265	39721	---	---	27864	27560	26806	25910
	---	---	93	140	141	113	---	---	115	249	297	236	---	---	192	456	544	472	---	---	304	754	896	658
	---	---	.0021	.0031	.0032	.0026	---	---	.0024	.0052	.0062	.0050	---	---	.0047	.0112	.0135	.0119	---	---	.0109	.0274	.0334	.0254
95-97	---	---	---	26817	26776	26701	---	---	---	30501	30433	30246	---	---	---	29243	29103	28777	---	---	---	19666	19447	18937
	---	---	---	41	75	60	---	---	---	68	187	120	---	---	---	140	326	262	---	---	---	219	510	413
	---	---	---	.0015	.0028	.0022	---	---	---	.0022	.0061	.0040	---	---	---	.0048	.0112	.0091	---	---	---	.0111	.0262	.0218
98-00	---	---	---	---	25157	25114	---	---	---	---	27694	27622	---	---	---	---	29545	29415	---	---	---	---	22343	22107
	---	---	---	---	43	58	---	---	---	---	72	94	---	---	---	---	130	244	---	---	---	---	236	361
	---	---	---	---	.0017	.0023	---	---	---	---	.0026	.0034	---	---	---	---	.0044	.0083	---	---	---	---	.0106	.0163
	Age at survey 60-69						**Age at survey 70-79**						**Age at survey 80-89**						**Age at survey 90 and above**					
	86-88	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**	**86-88**	**89-91**	**92-94**	**95-97**	**98-00**	**01-02**
86-88	24776	24172	22644	20862	18958	16702	16093	15345	13320	11165	8901	6666	5929	5396	4075	2796	1753	1035	756	641	379	207	122	94
	604	1528	1782	1904	2256	1576	748	2025	2155	2264	2235	1404	533	1321	1279	1043	718	280	115	262	172	85	28	8
	.0244	.0632	.0787	.0913	.1190	.0944	.0465	.1320	.1618	.2028	.2511	.2106	.0899	.2448	.3139	.3730	.4096	.2705	.1521	.4087	.4538	.4106	.2295	.0851
89-91	---	27172	26459	24790	22845	20607	---	19109	18148	15841	13272	10495	---	7285	6527	4875	3343	2092	---	866	702	400	239	156
	---	713	1669	1945	2238	1578	---	961	2307	2569	2777	1770	---	758	1652	1532	1251	601	---	164	302	161	83	30
		.0262	.0631	.0785	.0785	.0766		.0503	.1271	.1622	.2092	.1687		.1040	.2531	.3143	.3742	.2873		.1894	.4302	.4025	.3473	.1923
92-94	---	---	24894	24200	22733	20954	---	---	18528	17571	15311	12809	---	---	7423	6628	4956	3304	---	---	992	812	450	239
	---	---	694	1467	1779	1406	---	---	957	2260	2502	1745	---	---	795	1672	1652	917	---	---	180	362	211	70
			.0279	.0606	.0783	.0671			.0517	.1286	.1634	.1362	---		.1071	.2523	.3333	.2775			.1815	.4458	.4689	.2929
95-97	---	---	---	15718	15309	14362	---	---	---	12516	11856	10365	---	---	---	5392	4844	3470	---	---	---	427	310	155
	---	---	---	409	947	696	---	---	---	660	1491	1118	---	---	---	548	1374	845	---	---	---	117	155	55
				.0260	.0619	.0485				.0527	.1258	.1079				.1016	.2836	.2435				.2740	.5000	.3548
98-00	---	---	---	---	15470	15059	---	---	---	---	12572	11940	---	---	---	---	6333	5591	---	---	---	---	0	0
	---	---	---	---	411	602	---	---	---	---	632	981	---	---	---	---	742	1005	---	---	---	---	---	---
					.0266	.0400					.0503	.0822					.1172	.1798						

Table 5.3. Test of Proportional Hazards Assumption Based on Scaled Schoenfeld Residuals

	rho	chi2	df	Prob>chi2
Widowed	-0.0208	0.00	1	0.9979
Divorced	-0.0202	0.00	1	0.9980
Separated	-0.0160	0.00	1	0.9982
Never Married	-0.0612	0.00	1	0.9942
Cohort	0.0273	0.00	1	0.9977
Age at survey	-0.0390	0.00	1	0.9959
Female	0.0147	0.00	1	0.9984
Black	-0.0669	0.00	1	0.9929
Some College	-0.0354	0.00	1	0.9963
High School Graduate	-0.0566	0.00	1	0.9943
No High School Diploma	-0.0837	0.00	1	0.9920

Note: This is a proportional test based on evaluating scaled Schoenfeld Residuals. The "rho" parameter indicates the slope of change in a coefficient over time or time dependency in a given covariate's effect. The "chi2" column carry out a test of "rho"=0. Statistical significance indicates violation of proportional hazard assumption.

Table 5.4. Weighted Descriptive Characteristics by Marital Status for Selected Survey Year Cohorts (N=1,119,266)

		1986	2000
Married	Proportion of Total Sample	64.46	62.56
	Died (%)	18.74	2.10
	College Graduate (%)	19.62	27.44
	Mean Age	45.71	48.17
	Women (%)	50.25	49.86
	African Americans (%)	10.67	11.18
Widowed	Proportion of Total Sample	7.65	7.62
	Died (%)	61.09	10.68
	College Graduate (%)	7.73	10.16
	Mean Age	70.68	72.43
	Women (%)	84.46	82.13
	African Americans (%)	18.31	18.74
Divorced	Proportion of Total Sample	6.89	8.74
	Died (%)	19.36	2.80
	College Graduate (%)	14.92	20.20
	Mean Age	44.83	49.47
	Women (%)	63.51	39.49
	African Americans (%)	19.83	21.02
Separated	Proportion of Total Sample	2.15	1.96
	Died (%)	16.82	2.21
	College Graduate (%)	12.31	13.72
	Mean Age	41.97	44.19
	Women (%)	65.09	37.31
	African Americans (%)	47.63	42.13
Never Married	Proportion of Total Sample	18.85	19.12
	Died (%)	8.31	1.17
	College Graduate (%)	17.01	20.14
	Mean Age	28.45	30.87
	Women (%)	47.30	51.64
	African Americans (%)	25.86	29.55
N		39539	46474

Table 5.5. Trends in Marital Status Differences in Mortality from Cox Proportional Hazards Models, 1986-2000 (Based on data with full mortality follow-up)

	Model A	Model B	Model C	Model D
Marital Status(0=Married)				
Widowed	0.186***	0.143***	0.109***	0.172***
Divorced	0.338***	0.285***	0.326***	0.322***
Separated	0.369***	0.240***	0.246***	0.269***
Never Married	0.372***	0.295***	0.352***	0.252***
CohortXMaritial Status(0=Married)				
Cohort		-0.003*	-0.004*	-0.004*
CohortXWidowed		0.008***	0.009*	0.007**
CohortXDivorced		0.010**	0.013*	0.008
CohortXSeparated		0.026***	0.023*	0.021
CohortXNeverMarried		0.016***	0.015**	0.014***
Gender Interactions				
WidowedXWomen			0.038	
DivorcedXWomen			-0.075	
SeparatedXWomen			-0.015	
NeverMarriedXWomen			-0.121**	
CohortXWomen			0.002	
CohortXWidowedXWomen			-0.002	
CohortXDivorcedXWomen			-0.006	
CohortXSeparatedXWomen			0.008	
CohortXNeverMarriedXWomen			0.000	
Race Interactions				
WidowedXBlack				-0.241***
DivorcedXBlack				-0.230***
SeparatedXBlack				-0.087
NeverMarriedXBlack				0.230***
CohortXBlack				0.002
CohortXWidowedXBlack				0.011
CohortXDivorcedXBlack				0.014
CohortXSeparatedXBlack				0.010
CohortXNeverMarriedXBlack				0.000
Sociodemographic Variables				
Age at survey	0.014***	0.014***	0.014***	0.014***
Women	-0.516***	-0.516***	-0.513***	-0.517***
African Americans	0.171***	0.170***	0.172***	0.205***
Education (0=College Graduate)				
No High School Diploma	0.510***	0.510***	0.508***	0.507***
High School Graduate	0.340***	0.339***	0.338***	0.335***
Some College	0.241***	0.240***	0.238***	0.237***
F-value	982.95	658.11	421.98	436.52
N			912757	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05.

Table 5.6. Trends in Marital Status Differences in Mortality from Cox Proportional Hazards Models, 1986-2000 (Based on truncated data with two-year follow-up for each cohort)

	Model A	Model B	Model C	Model D
Marital Status(0=Married)				
Widowed	0.183***	0.085**	0.149**	0.095**
Divorced	0.347***	0.308***	0.405***	0.341***
Separated	0.418***	0.273**	0.243*	0.323*
Never Married	0.441***	0.343***	0.440***	0.264***
CohortXMaritial Status(0=Married)				
Cohort		-0.004	-0.007*	-0.005+
CohortXWidowed		0.014***	0.003	0.014**
CohortXDivorced		0.005	0.006	0.005
CohortXSeparated		0.020+	0.025	0.014
CohortXNeverMarried		0.014*	0.009	0.016*
Gender Interactions				
WidowedXWomen			-0.071	
DivorcedXWomen			-0.193+	
SeparatedXWomen			0.080	
NeverMarriedXWomen			-0.221*	
CohortXWomen			0.010*	
CohortXWidowedXWomen			0.008	
CohortXDivorcedXWomen			-0.004	
CohortXSeparatedXWomen			-0.015	
CohortXNeverMarriedXWomen			0.009	
Race Interactions				
WidowedXBlack				-0.072
DivorcedXBlack				-0.164
SeparatedXBlack				-.073
NeverMarriedXBlack				0.438***
CohortXBlack				0.007
CohortXWidowedXBlack				-0.005
CohortXDivorcedXBlack				-0.004
CohortXSeparatedXBlack				0.006
CohortXNeverMarriedXBlack				-0.019
Sociodemographic Variables				
Age at survey	0.304***	0.305***	0.305***	0.305***
Women	-0.602***	-0.601***	-0.634***	-0.601***
African Americans	0.236***	0.235***	0.237***	0.202***
Education (0=College Graduate)				
No High School Diploma	0.545***	0.545***	0.541***	0.542***
High School Graduate	0.394***	0.393***	0.389***	0.388***
Some College	0.245***	0.244***	0.241***	0.240***
F-value	294.43	197.92	128.73	134.81
N			912757	

Two-tailed tests: ***p<0.001; **p<0.01; *p<0.05; +p<0.1.

Figures

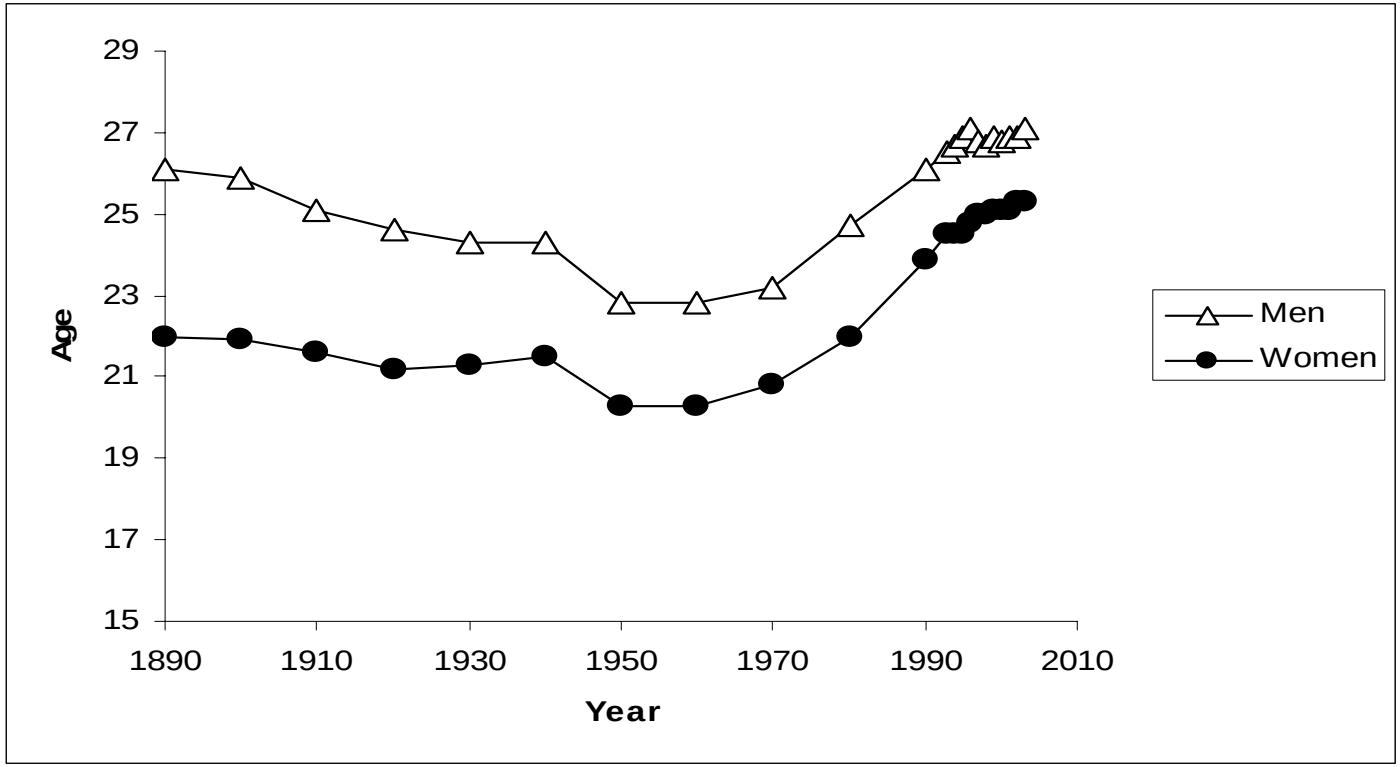

Figure 2.1. United States Median Age at First Marriage, 1890-2003

Source: U.S. Bureau of the Census, Information Please® Database, © 2006 Pearson Education, Inc.

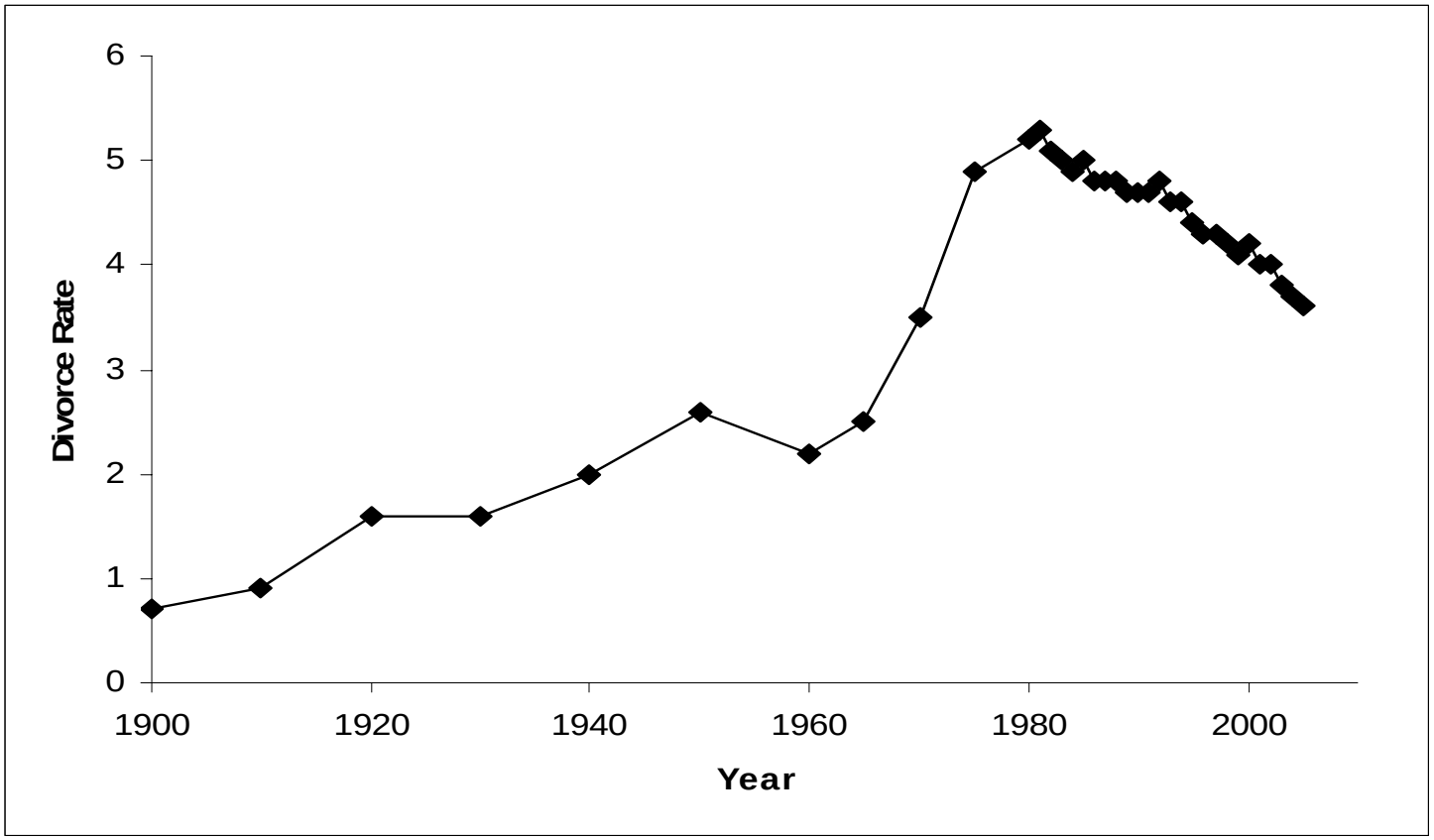

Figure 2.2. United States Divorce Rate per 1,000 Population, 1900-2005

Source: U.S. Dept. of Health and Human Services, National Center for Health Statistics. Information Please® Database, © 2006 Pearson Education, Inc.

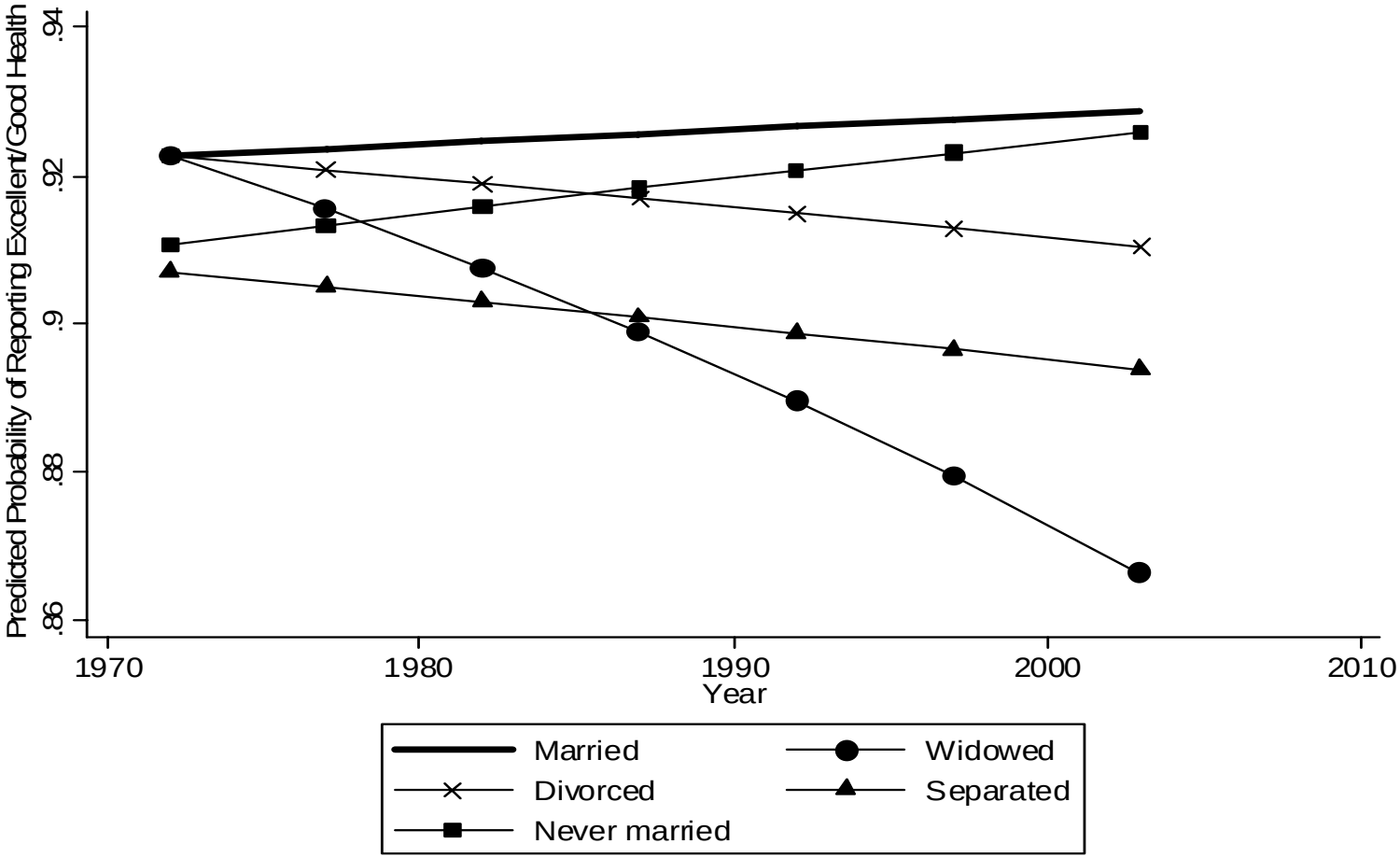

Figure 3.1. Estimated Trends In Self-Rated Health by Marital Status, 1972-2003

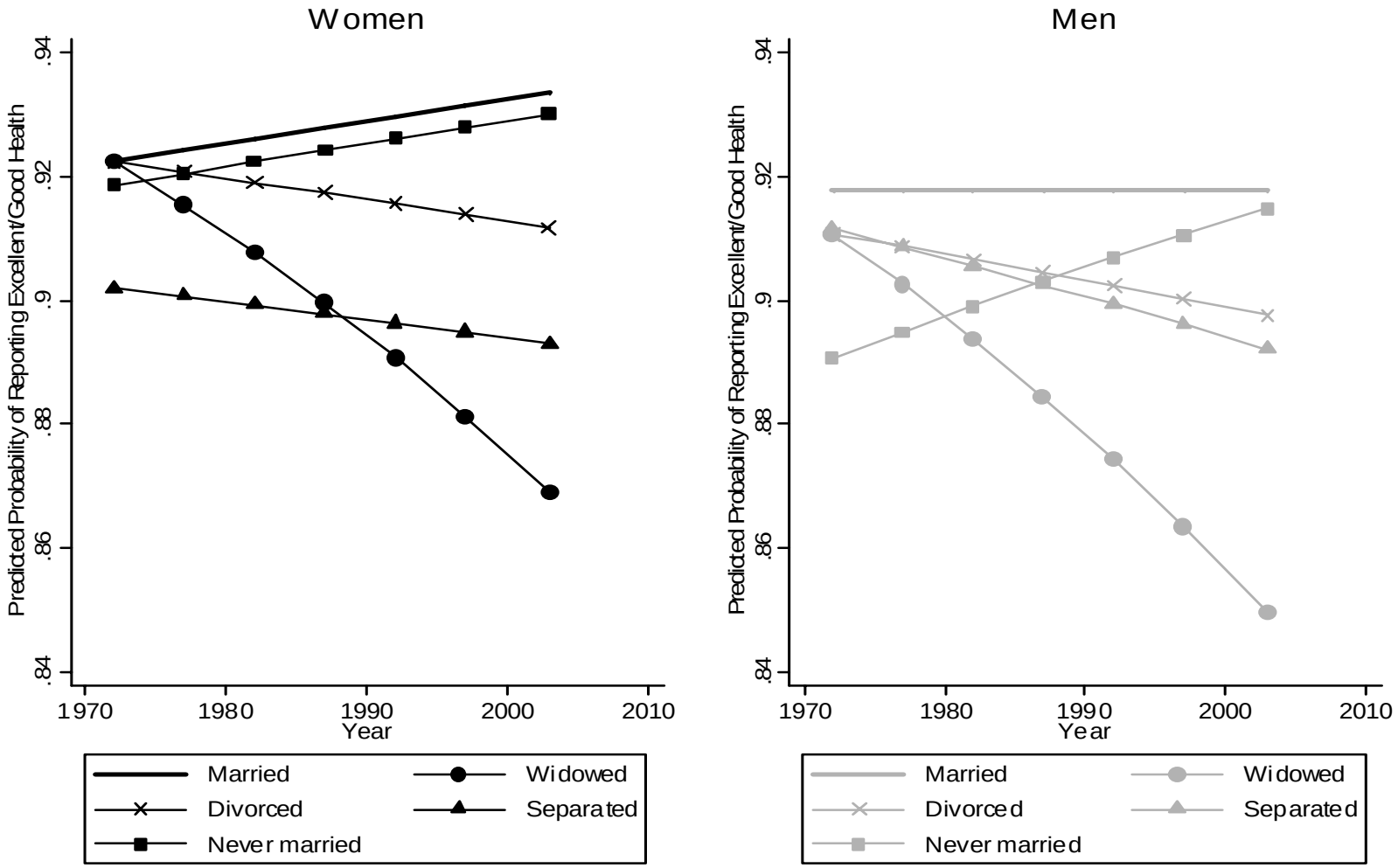

Figure 3.2. Estimated Trends In Self-Rated Health by Marital Status and Gender, 1972-2003

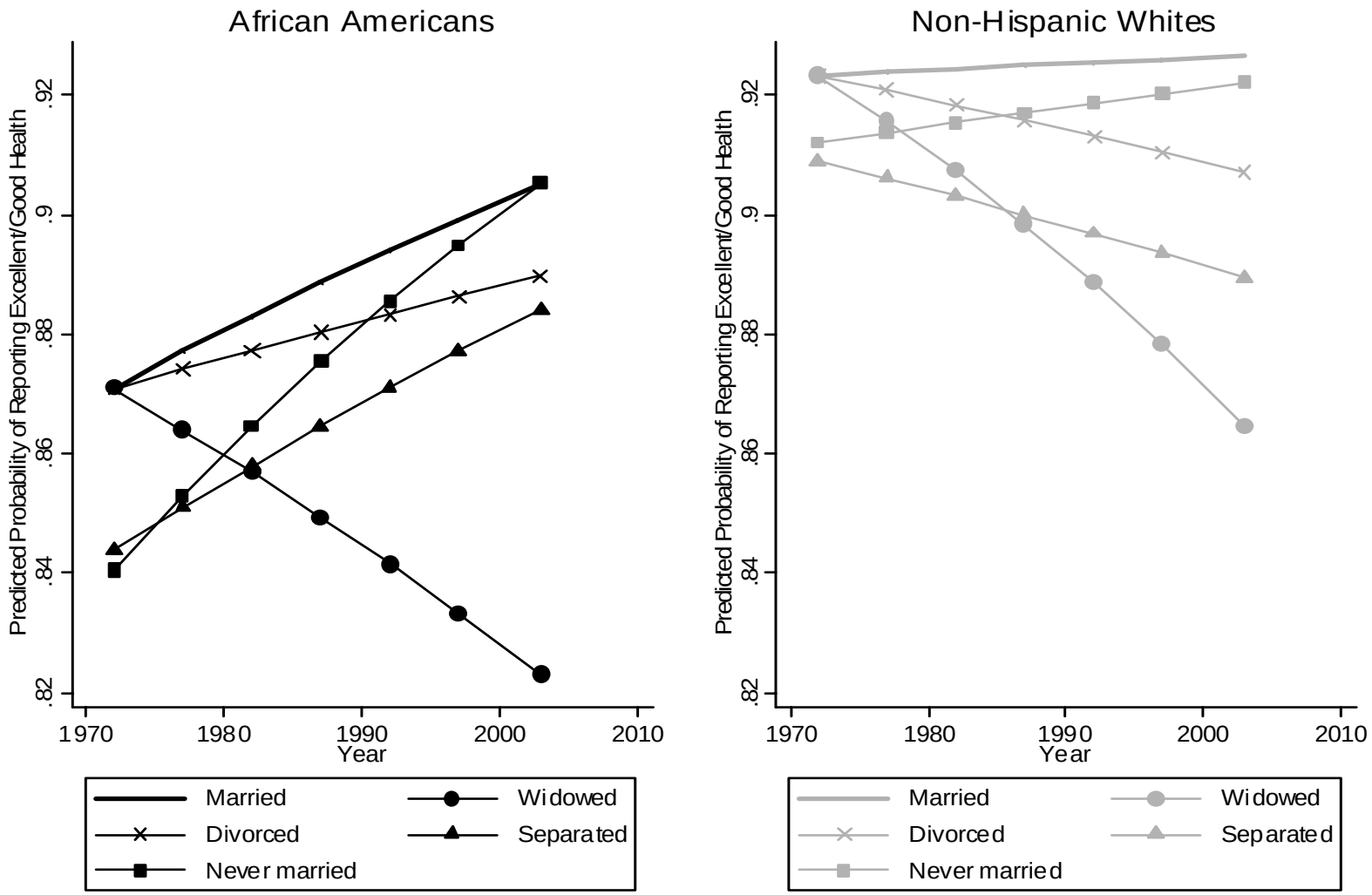

Figure 3.3. Estimated Trends In Self-Rated Health by Marital Status and Race, 1972-2003

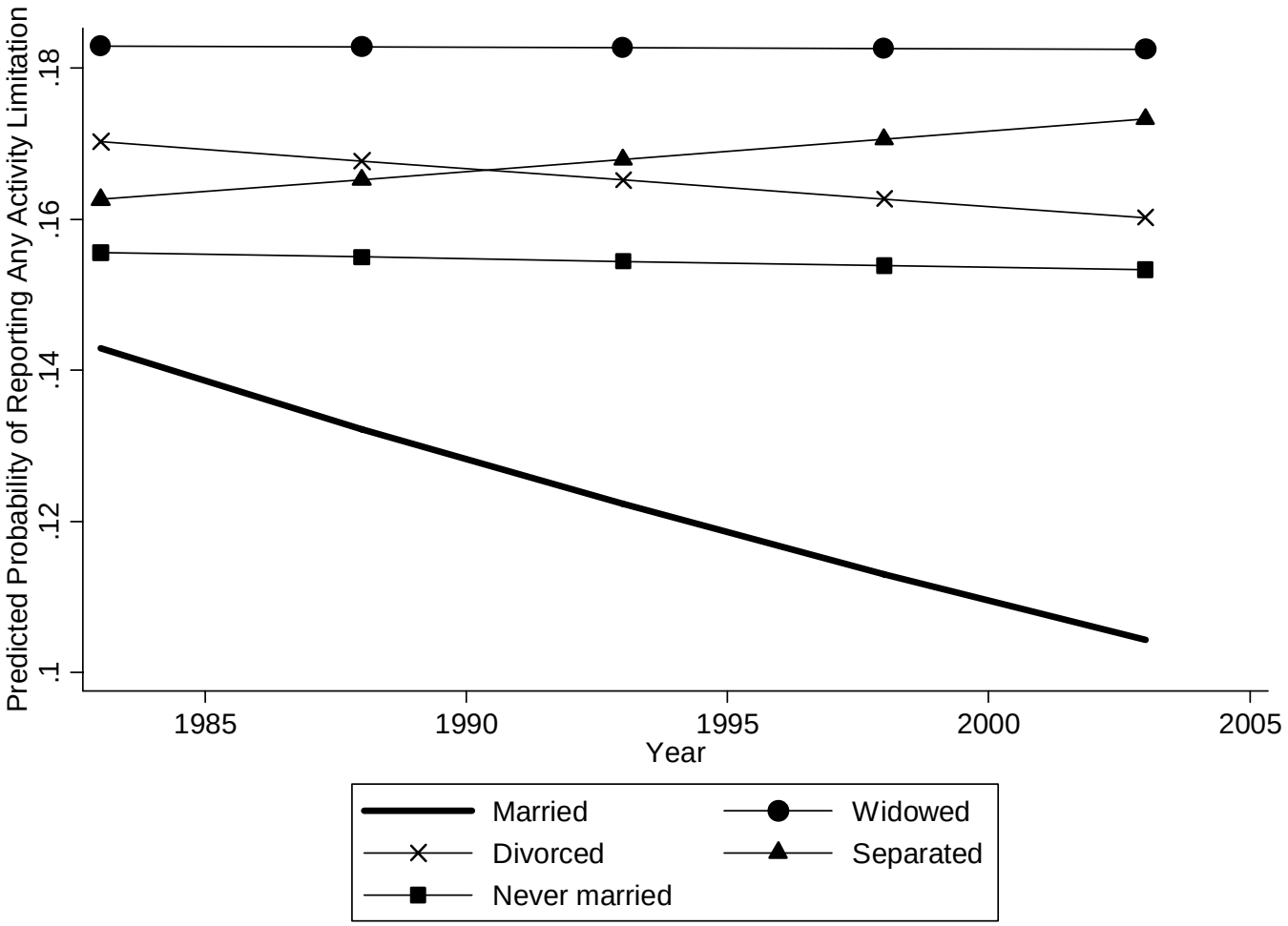

Figure 4.1. Estimated Trends In Activity Limitation Status by Marital Status, 1983-2003

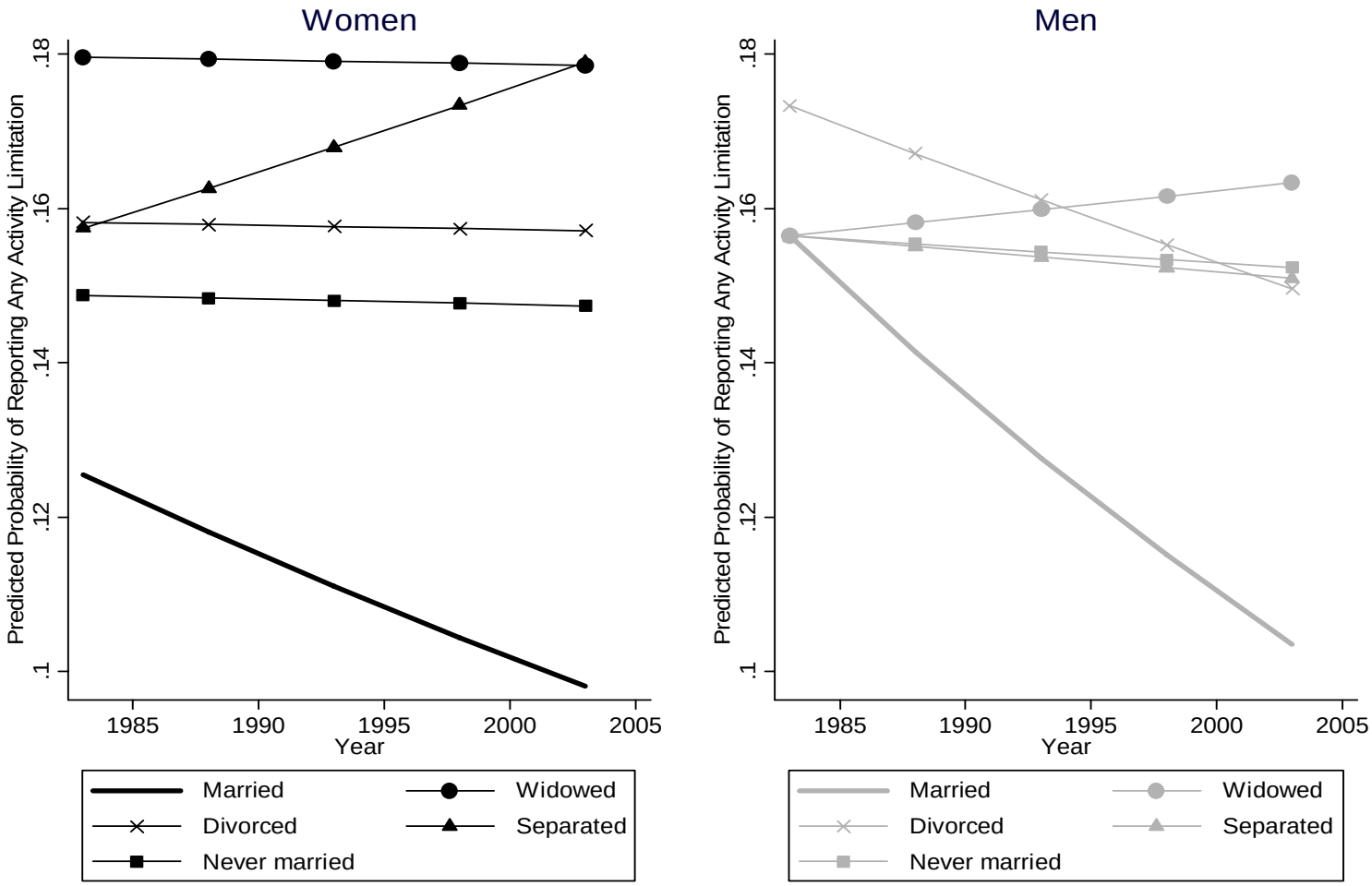

Figure 4.2. Estimated Trends In Activity Limitation Status by Marital Status and Gender, 1983-2003

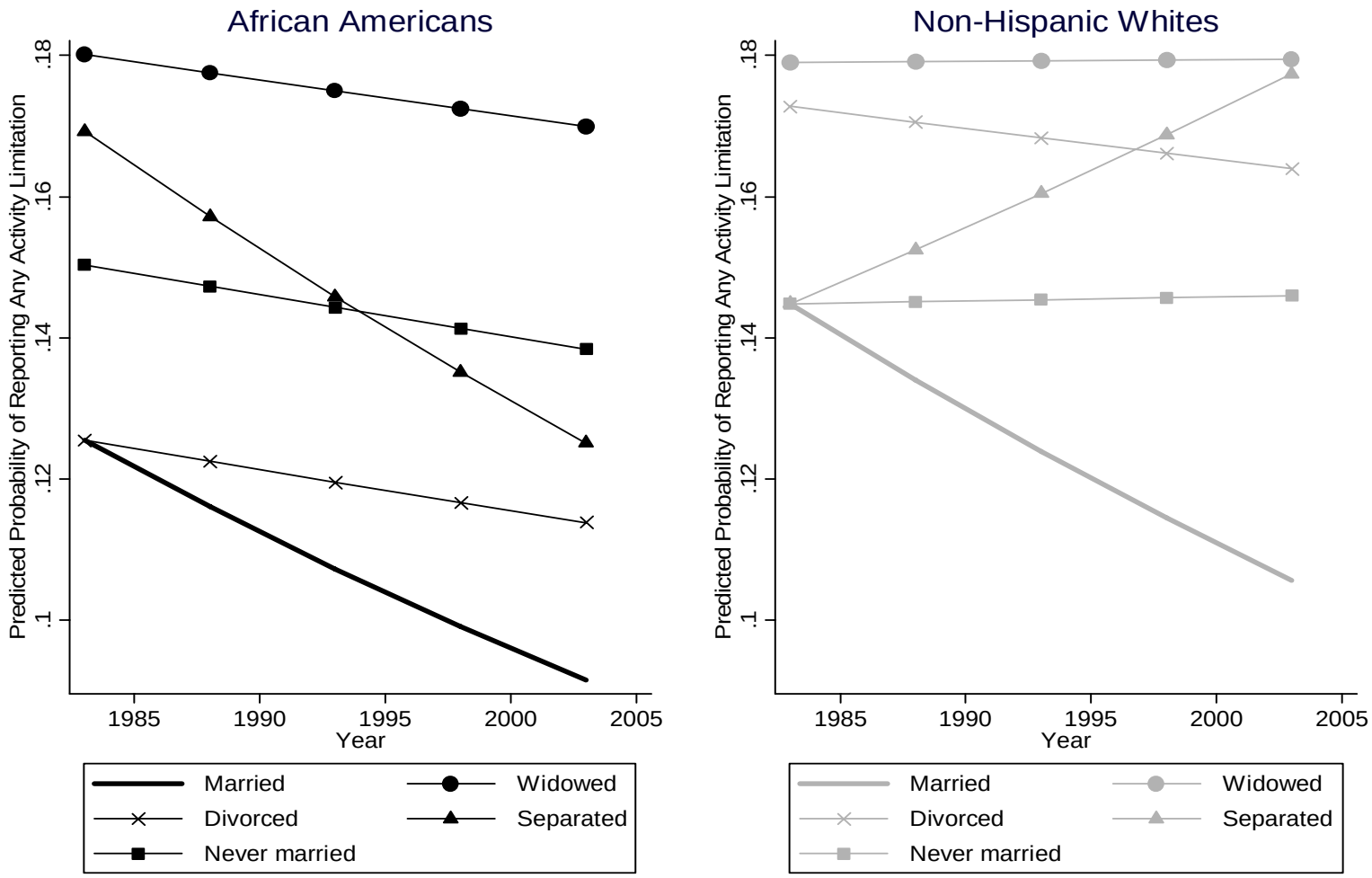

Figure 4.3. Estimated Trends In Activity Limitation Status by Marital Status and Race, 1983-2003

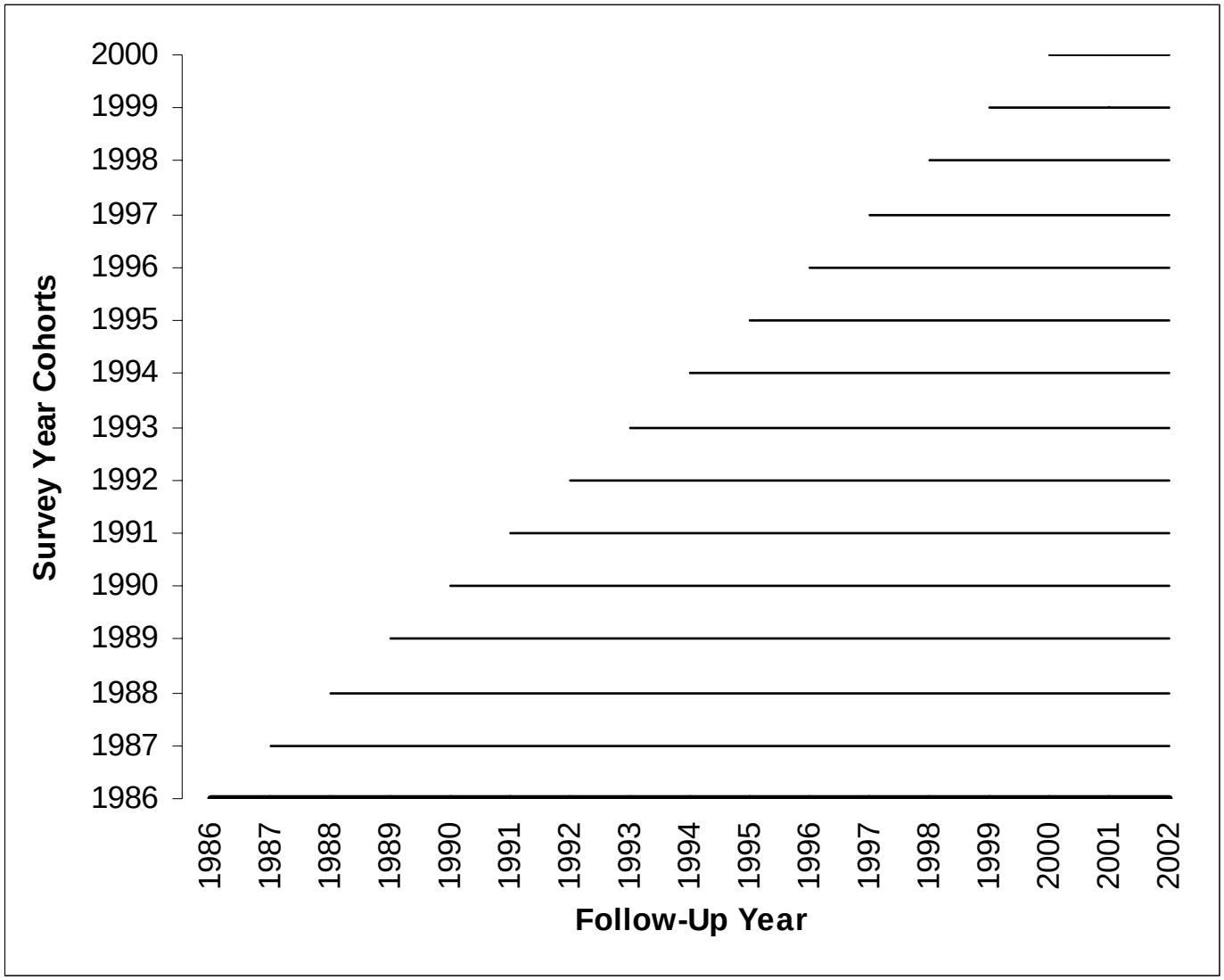

Figure 5.1. Data Structure of The National Health Interview Survey Linked Mortality Files 1986-2000

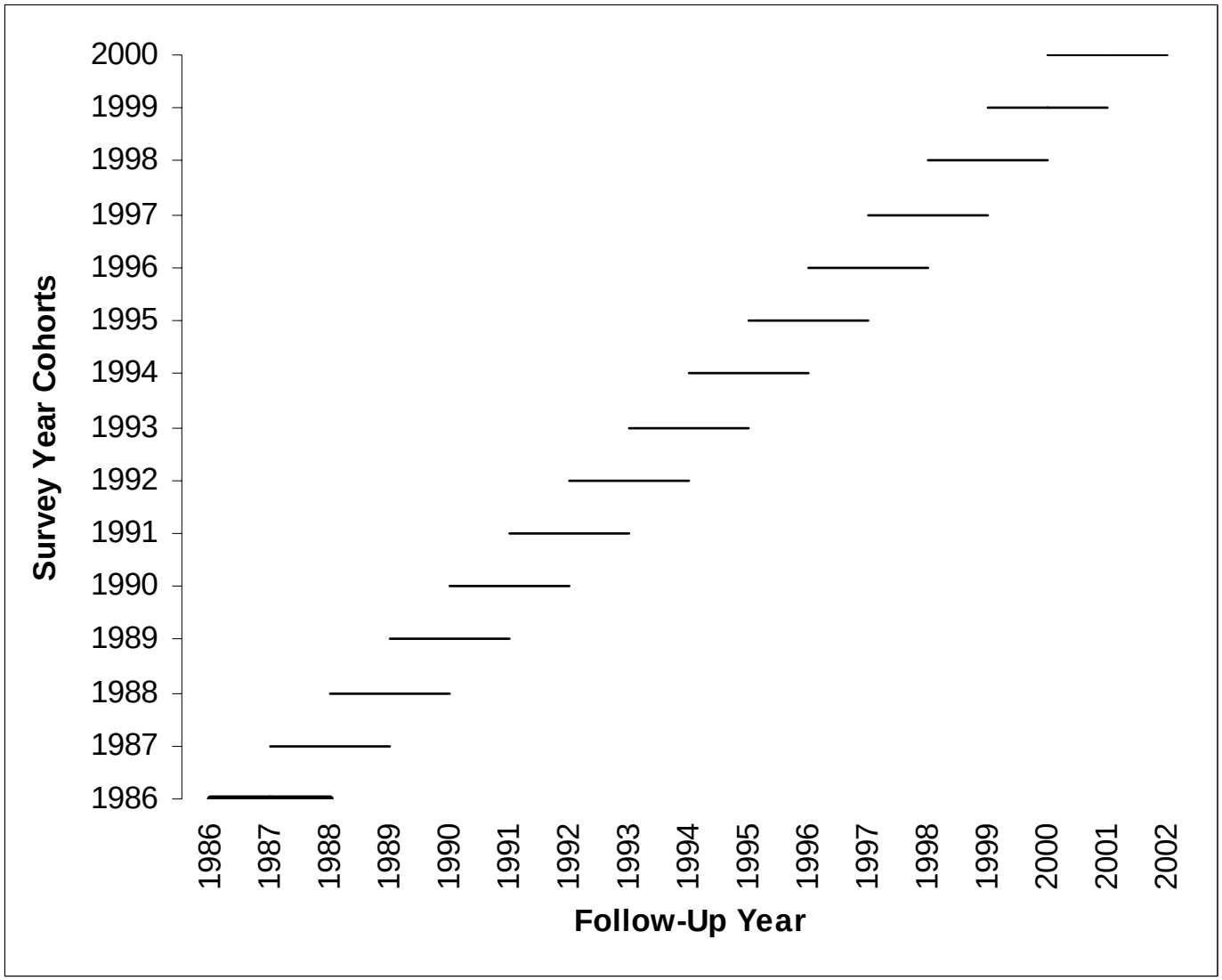

Figure 5.2. Truncated Data Structure of The National Health Interview Survey Linked Mortality Files 1986-2000

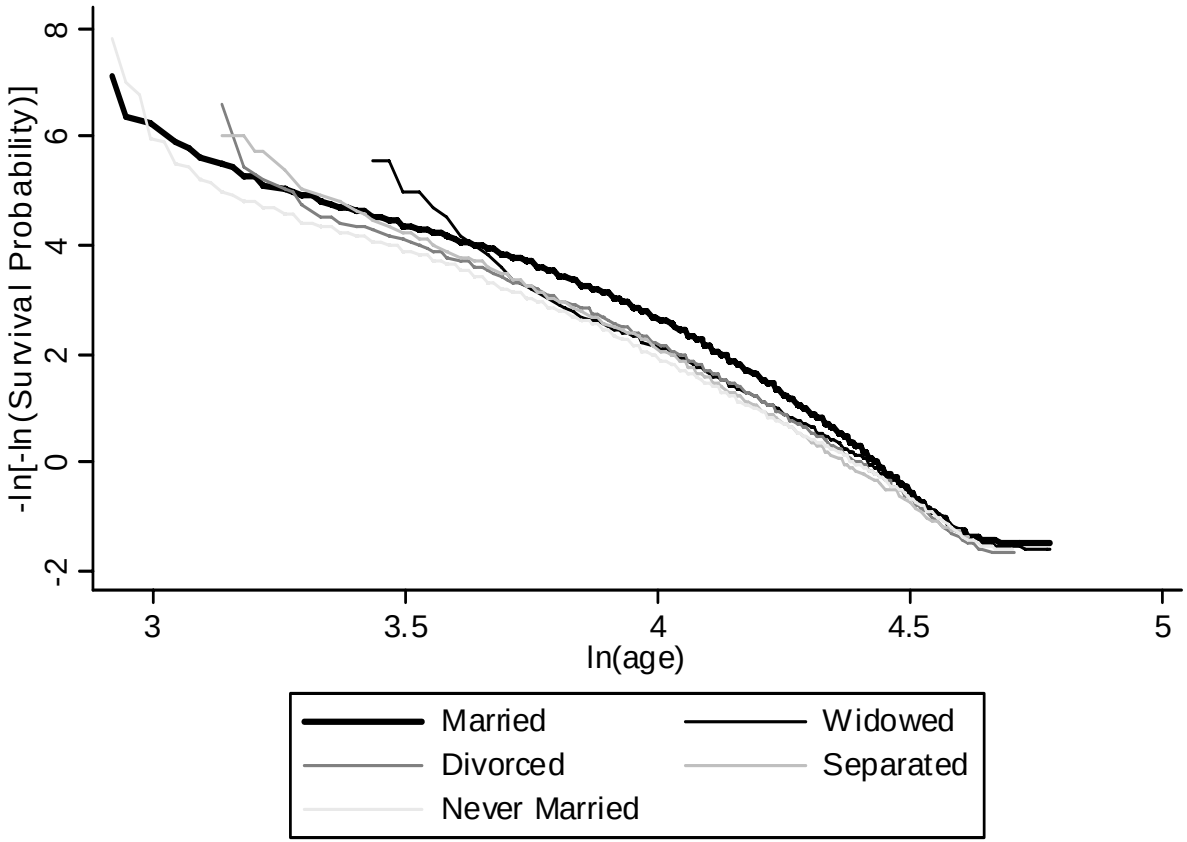

Figure 5.3. Graphical Check on Proportional Hazards Assumption for Marital Status

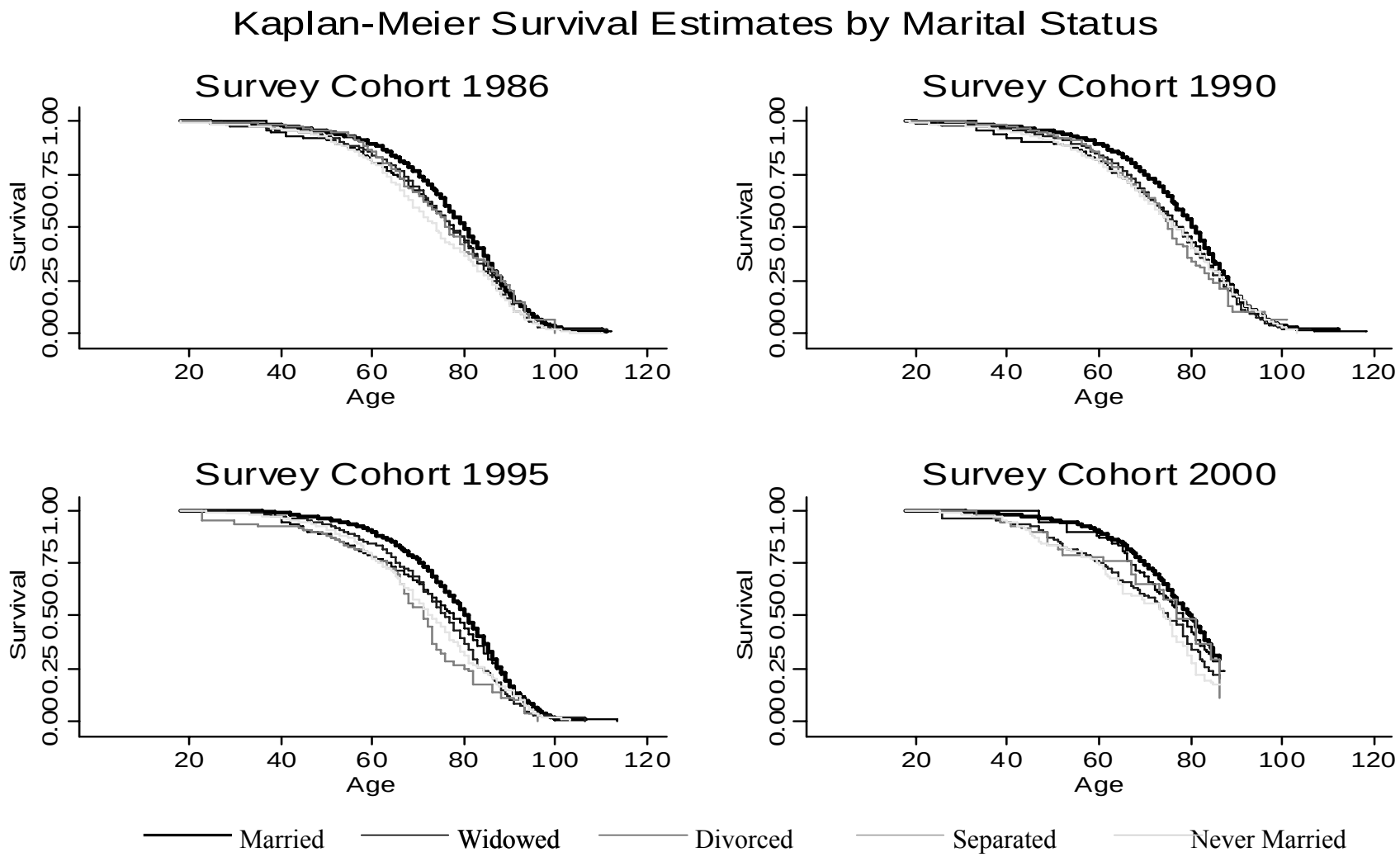

Figure 5.4. Kaplan-Meier Survival Curves By marital Status and Selected Survey Year Cohorts

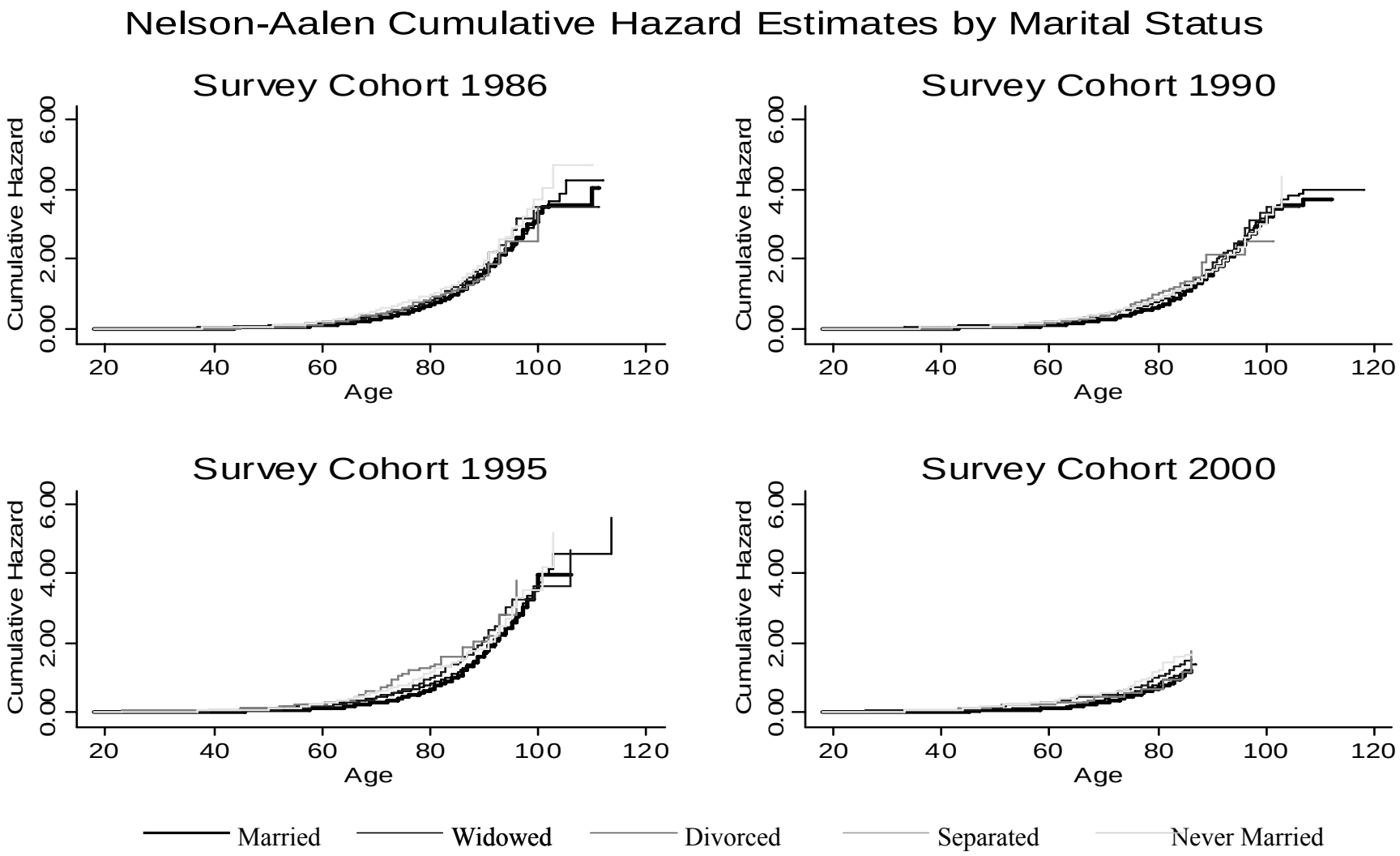

Figure 5.5. Nelson-Aalen Cumulative Hazard Curves by Marital Status and Selected Survey Year Cohorts

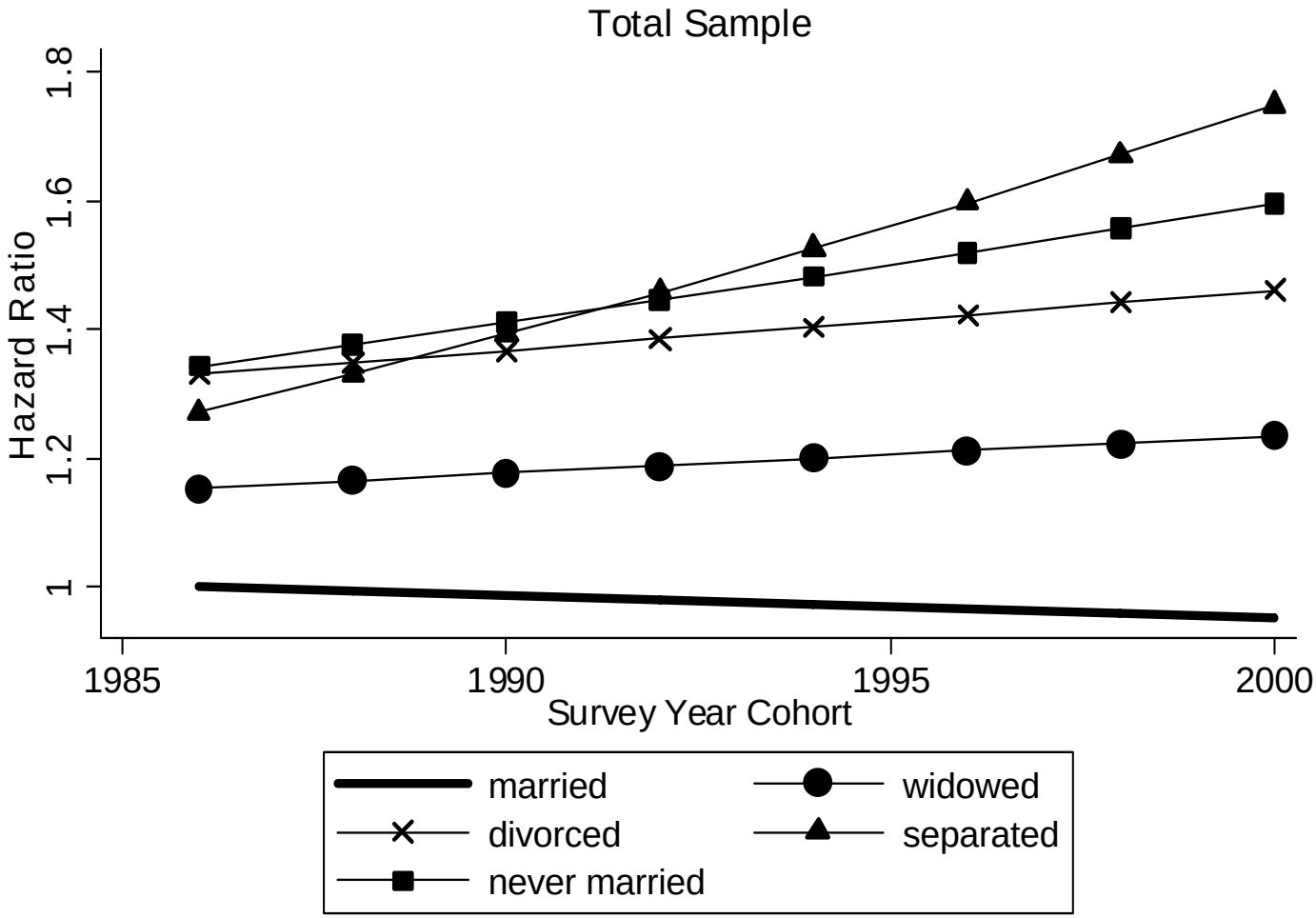

Figure 5.6. Predicted Trends in Death Hazard Ratios By Marital Status

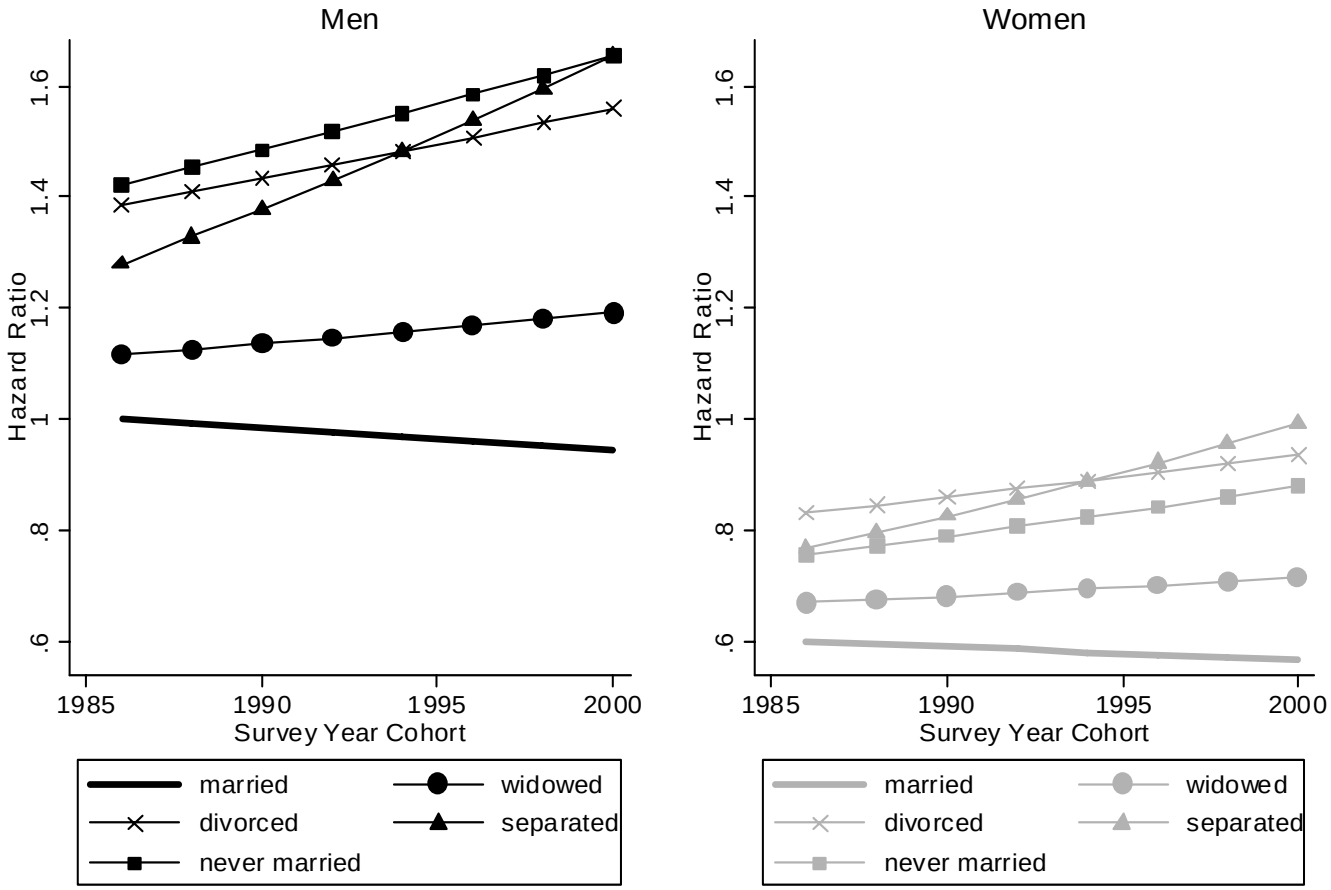

Figure 5.7. Predicted Trends in Death Hazard Ratios By Marital Status and Gender

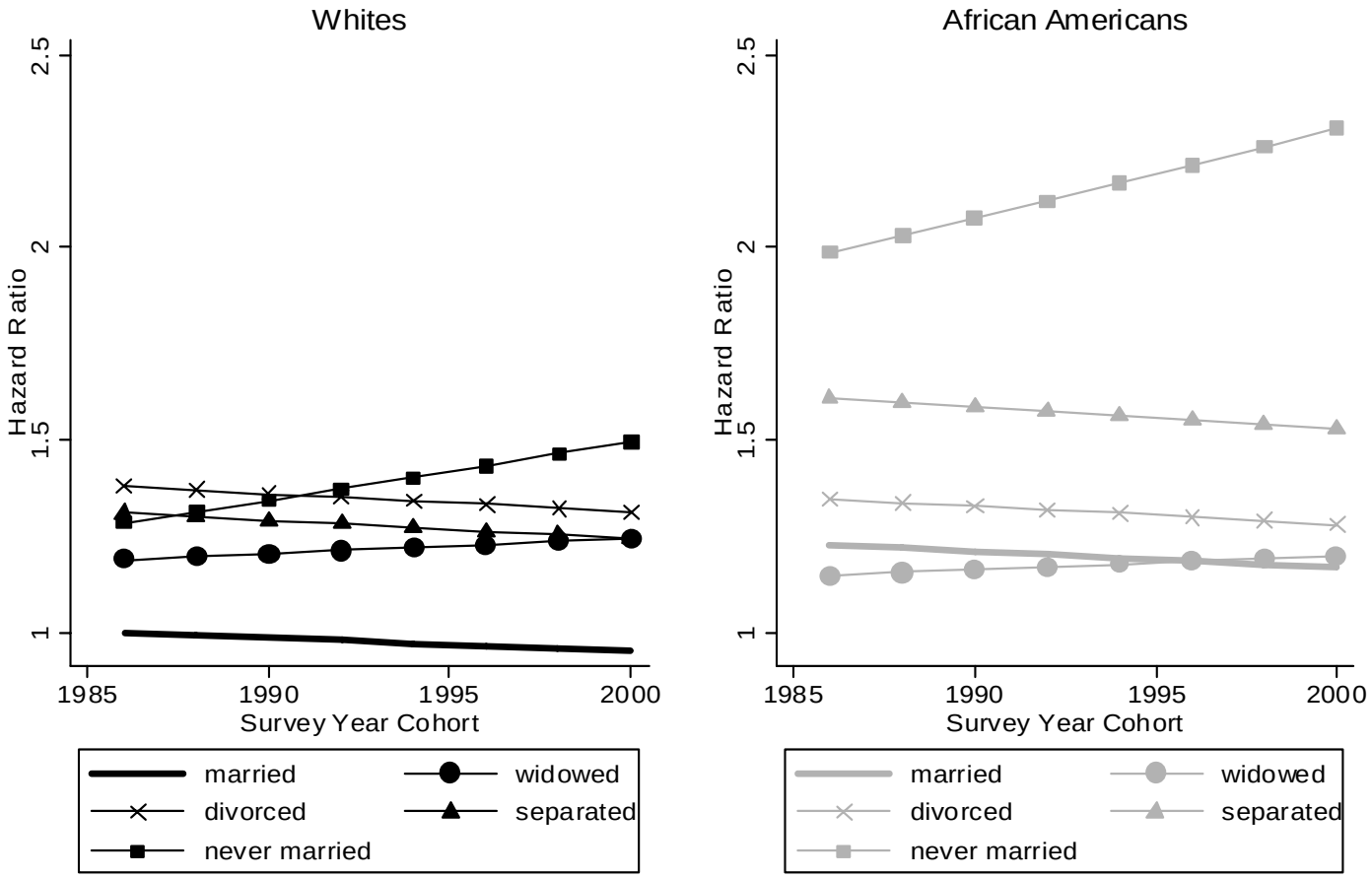

Figure 5.8. Predicted Trends in Death Hazard Ratios By Marital Status and Race

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